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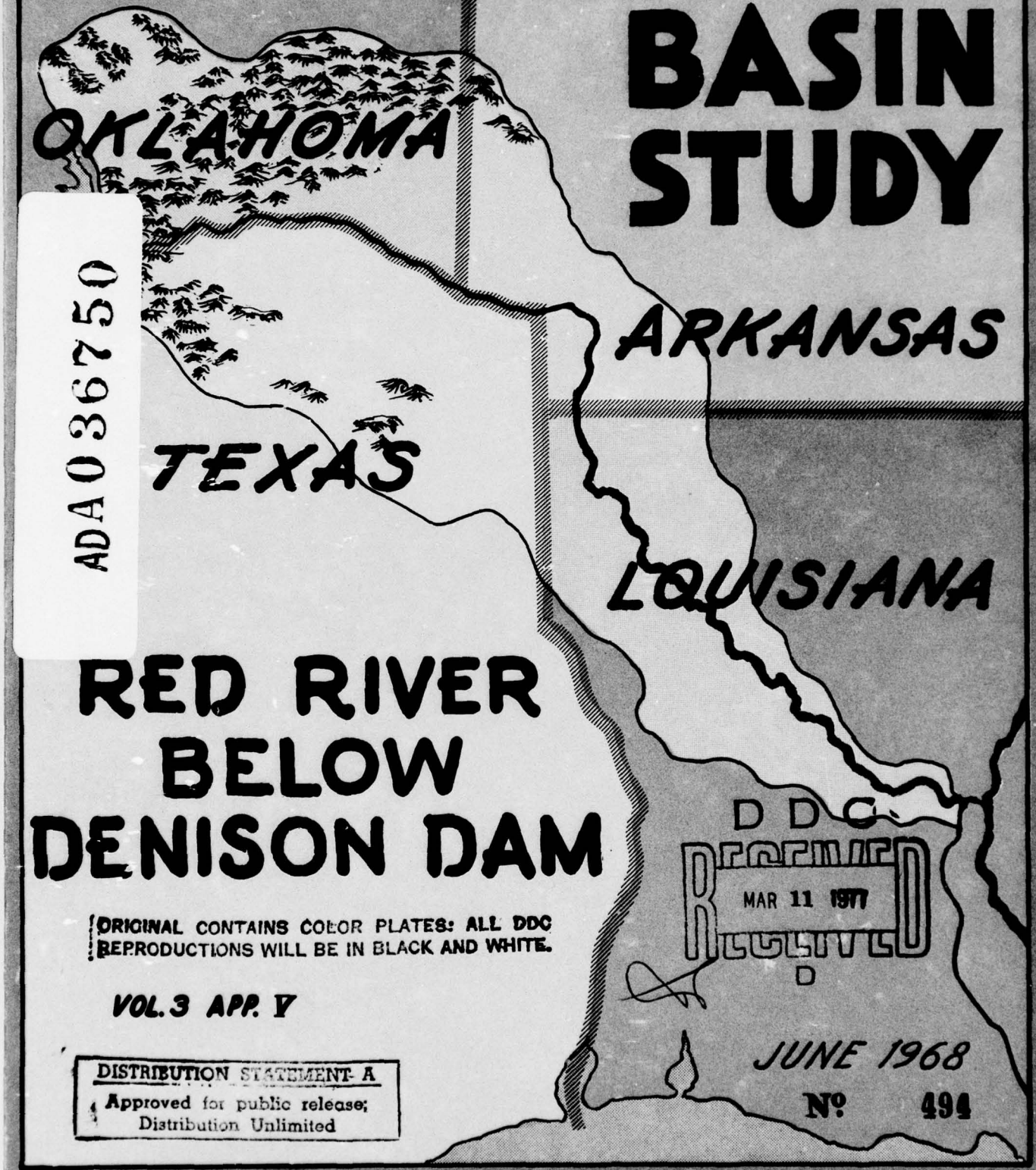

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RED RIVER BELOW DENISON DAM

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RED RIVER BELOW DENISON DAM
ARKANSAS, LOUISIANA, OKLAHOMA, AND TEXAS
COMPREHENSIVE BASIN STUDY

VOLUME INDEX

(6) Comprehensive Basin Study.

RED RIVER BELOW DENISON DAM,
ARKANSAS, LOUISIANA, OKLAHOMA, AND TEXAS
COMPREHENSIVE BASIN STUDY

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APPENDIX V

UPSTREAM WATERSHED PROTECTION, USE,
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ERRATA SHEET

The USDA recommended and alternative project plans for lower Bois d'Arc Creek Watershed (3-25) and upper Bois d'Arc Creek Watershed (3-25a) are tabulated incorrectly in the final section of Appendix V. The alternative plan, which includes Bonham Reservoir, 22 upstream reservoirs, and 30.3 miles of channel improvements, should be the plan recommended by USDA for the early-action program. The USDA plan, which includes 41 upstream reservoirs and 30 miles of channel improvements for these watersheds, should be the alternative plan. Accordingly, data shown for these watersheds in tables 72, 73, 75, and 76 should be interchanged with similar data in tables 80, 81, 82, and 83.

COMPREHENSIVE BASIN STUDY INTERAGENCY REPORT APPENDICES

Red River Below Denison Dam
Arkansas, Louisiana, Oklahoma, and Texas

Appendix No.	Title	Responsible Agency
I	Economics	USAE
II	Climate and Meteorology	USDC
III	Hydrology, Surface and Ground Water, and Geology	USAE & USGS
IV	Flood Control and Major Drainage	USAE
V	Upstream Watershed Protection, Use, Management, and Development	USDA
VI	Irrigation	USDA & BR
VII	Drainage and Flood Prevention on Flatlands	USDA
VIII	Mineral Resources and Mineral Industry	BM
IX	Archeological, Historical, and Natural Resources	NPS
X	Hydroelectric Power	FPC, SPA & USAE
XI	Water Supply and Water Quality Control	FWPCA
XII	Outdoor Recreation	BOR
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XV	Plan Formulation	Plan Formulation Task Force

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SUMMARY

Upstream watershed protection, use, management, and development investigations in the Red River Basin Study Area were made by the Soil Conservation Service, Forest Service, and Economic Research Service of the U. S. Department of Agriculture. The purposes of ~~the investigations~~ this document is ~~were~~ to: (1) identify water and related land resource problems; (2) prepare a potential plan for water and related land resource development that could be accomplished under USDA programs; (3) prepare agricultural and forestry data for use of cooperating agencies in planning water and related land resource projects under their programs; and (4) compile engineering, economic, and related data that local organizations could use for developing water and related land resources. All investigations were coordinated with investigations of other cooperating agencies. December 31, 1962, was selected by USDA as the planning base.

The Study Area extends from Denison Dam in Oklahoma and Texas to a point near the mouth of the Red River in Louisiana. It includes all of the drainage area between these points except for the drainage area of the Ouachita River and Black River and Concordia Parish in Louisiana. The Study Area includes approximately 29,610 square miles (18,950,272 acres) in all or parts of 60 counties and parishes in parts of Arkansas, Louisiana, Oklahoma, and Texas. Geology and relief vary substantially and mean sea level elevations range from 40 feet to 2,600 feet. The dendritic drainage pattern consists of 193 Conservation Needs Inventory (CNI) watersheds within 24 tributary basins. About 289,300 acres, or 1.5 percent of the total area, are permanent water surfaces such as larger lakes, streams, sloughs, and canals. The land area of 18,661,000 acres is about 55 percent forest and woodland, three percent miscellaneous land, 35 percent cropland, pasture, and rangeland, and the remaining seven percent is land not inventoried as to land use.

The 1962 population was about 1,757,400 or about 59 persons per square mile. About 49 percent of the population live in urban areas, 40 percent in rural towns, and 11 percent on farms. Farm population decline began in 1930 and is continuing. The Study Area included about 77,150 farms in 1962 with an average size of 190 acres. Farm numbers are decreasing and farm sizes are increasing. The 1962 value of farm products sold was about $297,669,500, or about $3,860 per farm. Livestock and livestock products provided about 56 percent of all farm income.

Population projections and projections of economic activity were made to provide a basis for determining needs for additional water and related land resource development. Projections indicate that deficits in agricultural production needs allocated to the Study Area can be expected by 1980. Deficits will increase by 2010. Additional water and related land resource development would provide opportunities to meet production needs. Watershed project developments also are needed to meet projected needs for flood prevention, municipal and industrial water supplies, pollution abatement, rural and domestic water supplies, recreation, and rural area redevelopment by 1980 and in subsequent periods.

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Water and related land resource problems were identified in each of the 193 CNI watersheds. Principal problems include flooding, inadequate drainage, water pollution, inadequate recreation development, drought, and inadequate municipal and industrial water supplies. Problems and needs vary in each of the CNI watersheds. The nature and severity of the problems provided a basis for selecting watersheds for initial and long-range development. Sixty-five CNI watersheds were selected for initial development (within the next 10-15 years), six CNI watersheds were selected for long-range development (beyond the next 10-15 years), and 122 CNI watersheds were considered not feasible for development. Thirteen of the 65 watersheds in the initial development category had been approved for watershed project operations under P. L. 566 prior to 1963. A total of 25 watershed projects had been approved for P. L. 566 operation in 27 CNI watersheds through 1966, and construction was completed on seven projects.

Soil erosion, soil limitation, and excess water problems adversely affect agricultural and forestry production on 16,559,800 acres, or nearly all of the productive base area. The nature and severity of the problems vary by major resource areas and land uses. Conservation treatment consisting of land user conversions and the common soil and water conservation practices has been applied to about one-fourth of the Study Area.

Existing water and related land resource development includes 13 CNI watershed projects authorized for P. L. 566 operations, 20 U. S. Army Engineers reservoir projects, six Forest Service reservoir projects on public land, and 12 State, municipal, and private reservoir projects. These projects were authorized for operations prior to December 31, 1962, and include water storage for flood prevention, irrigation, municipal water supply, and recreation purposes. Drainage improvement is a corollary purpose in one project.

Water and related land resource potential for development under USDA programs was appraised. Potential projects were identified in 52 CNI watersheds for initial development. Projects would include land treatment and structural measures for watershed protection, drainage, flood prevention, water quality control, recreation, municipal and industrial water supply, and irrigation purposes. Single-purpose reservoir storage could be added in four of the CNI watersheds to meet water quality control, recreation, and municipal and industrial water supply needs. Additional storage would be available in most reservoir sites.

Seven single-purpose recreation reservoirs, including aggregate storage of 2,870 acre-feet and 507 surface acres, are proposed for initial development in National Forests.

Potential multiple-purpose projects were identified for long-range development in six CNI watersheds. Projects would include land treatment and structural measures for watershed protection, drainage, flood prevention, recreation, and municipal and industrial water supply needs. Ten additional single-purpose reservoir projects to meet long-range recreation and irrigation water needs were identified in five CNI watersheds that were

identified for initial and long-range development. Structural measures would include 30.3 miles of channel improvement and 38 reservoirs with 161,469 acre-feet of useful storage.

Reservoir site development opportunities to meet water quality control, recreation, municipal water supply, and irrigation projected needs for initial and long-range development were identified in 39 non-feasible CNI watersheds. Reservoir useful storage capacity of 768,665 acre-feet could be developed. An additional 803,975 acre-feet of storage is available in these sites.

Project plans for CNI watershed development were prepared to integrate U. S. Army Engineers reservoir site development proposals for Parker, Bonham, Durant, and Kisatchie Reservoirs. The first three reservoirs would reduce the upstream watershed project size, and the Kisatchie Reservoir would eliminate the potential for early-action upstream watershed development in three CNI watersheds. Some of the combined project plans would include water storage for interbasin transfer.

Alternate water supplies for irrigation needs are also available to meet 2030 needs. Surface water supplies would provide better quality water than Red River supplies and should be given a higher development priority for irrigation development.

Land resource development potential can be realized by adoption of improved production practices and adjustments in land use. Establishment and maintenance of conservation practices is needed to maintain and improve agricultural and forestry productivity. Existing agricultural programs are being used for land resource development.

The most obvious impacts of potential project development are conversions of land to water areas. Existing, authorized, and potential projects would increase permanent water surfaces from 289,300 acres in 1962 to 745,400 acres in 1980. The productive base for agriculture and forestry would decrease from 17,333,300 acres in 1962 to 16,782,000 acres in 1980. Part of the decrease would result from increases in area devoted to urban, built-up, and small water uses. These changes and projected major land use changes would decrease total land treatment requirements, but would require increased use of cropland conservation practices.

Potential projects will contribute to meeting increased agricultural production requirements in 1980 by allowing formerly flooded and poorly drained land to be farmed more intensively. Irrigation projects will increase agricultural production. Projected 1980 agricultural production with potential projects and programs will provide about 96 percent of projected feed unit needs.

Potential projects would result in favorable overall agricultural economic impacts such as increased rural employment and income. Reduction of woodland acreage would affect forest industry and related employment adversely. Expected reductions in bottomland hardwood acreages will have detrimental effects on the hardwood industry.

USDA potential projects and programs will have only minor effects on water yields in most years. Benefits from further reduction of remaining flood damages in the Red River alluvial area upstream from Fulton, Arkansas, may be expected.

USDA is recommending early action in the development of improvements urgently needed to solve watershed problems and to meet estimated needs through 1980. Upstream watershed improvements include structural and land treatment measures. About 24 percent of the Study Area is included in early-action development. About 501,600 acres will require acceleration of installation of land treatment measures in upstream watershed projects.

Installation costs of structural measures would amount to $116,277,900 including $108,643,510 for multiple-purpose projects, and $7,634,390 for single-purpose projects. Total annual costs are $5,308,470 and annual benefits are $13,309,635.

INTRODUCTION

This Appendix by the U. S. Department of Agriculture (USDA) is one of 15 appendices to the Red River Basin Comprehensive Study (RRBCS) interagency report. The Field Coordinating Committee (FCC) assigned to USDA primary responsibility for Appendix VI (Irrigation), Appendix VII (Drainage and Flood Prevention on Flatlands), and Appendix V (Upstream Watershed Protection, Use, Management, and Development). This Appendix is concerned with upstream watershed problems, water and land development needs, potential for development of water, and related land resources, and with identification and descriptions of watershed projects that need to be initiated within the next 10-15 years. Other appendices to the interagency report are listed on page i.

Recommendations contained in this Appendix for upstream watershed projects are USDA recommendations to the FCC for basin plan formulation. Recommended upstream watershed projects were formulated to meet future needs for water and related land resource development insofar as USDA programs could be adapted to meeting the needs. Needs for resource development are described in this Appendix and other Appendices. Combined project plans were prepared cooperatively with the U. S. Army Engineers to integrate major reservoir site development proposals with upstream watershed projects in several upstream watersheds. Data for combined projects also are included in this Appendix for consideration by the FCC in basin plan formulation. Data for upstream watershed projects and for combined projects are presented in sufficient detail in this Appendix to enable the FCC to select appropriate projects for inclusion in the basin plan. The basin plan will be discussed in the Plan Formulation Appendix and the Summary Report.

AUTHORITY

The USDA participated in the Red River Basin Comprehensive Study under authority provided by Section 6 of the Watershed Protection and Flood Prevention Act of the 83rd Congress (Public Law 566, as amended). The Act is administered by the Soil Conservation Service (SCS) of the USDA. It authorizes the USDA to cooperate with other Federal, State, and local groups or agencies in surveys and investigations of river basins as a basis for development of coordinated programs.

OBJECTIVES

The USDA study was designed to develop agricultural and forestry data for the use of cooperating agencies and to prepare a potential plan of development for water and related land resources that could be accomplished under USDA programs. Agricultural data is needed by State and other Federal agencies as a basis for planning water and related land resource projects under their programs. A potential plan of development under USDA programs is needed for preparation and selection of an overall plan for water and related land resources development in the Study Area.

The primary objective of the USDA Study is to facilitate the coordination and orderly investigation, development, utilization, and management of water and related land resources of the Study Area. Achievement of this aim necessitated a general appraisal of the upstream water and land resource problems and an appraisal of the potential for resource development. This included:

(1) An inventory and description of water and related land resource problems and the general approaches that appear appropriate for their solution.

(2) Studies and projections of economic development.

(3) Translations of such projections into needs for water and related land resource uses.

(4) Appraisals of the availability of water supplies both as to quantity and quality.

(5) Appraisals of the availability of the related land resources.

(6) Studies and identification of projects which need to be initiated during the next 10-15 years.

(7) Studies to determine the extent to which recreation, fish and wildlife habitat improvement, flood control, drainage, irrigation, water quality control, and water supplies for rural, municipal and industrial uses can be provided by water and related land resource developments and programs in upstream areas to satisfy needs.

(8) A compilation of economic, engineering, and related data that local organizations could use for developing water and related land resources.

NATURE, SCOPE, AND INTENSITY OF INVESTIGATIONS

The Red River Basin below Denison Dam Study is defined as a Type II comprehensive detailed survey. A study of this type includes the major elements of a Type I Study (Objectives 1 thru 5) plus intensive studies of specific projects, the installation of which will need to be initiated within the next 10-15 years.

Basin conditions that existed on December 31, 1962, were selected by the USDA to represent the planning base. All potential improvements and evaluations of impacts of the potential improvements were referenced to the 1962 base year. A project evaluation maximum period extending from 1980 to 2080 was selected for use by all cooperating agencies. An agricultural projection period extending from 1962 to 2010 was used for major crops and other agricultural commodities. Agricultural census data, through 1959, were primary guides for establishing the agricultural planning base, and these were adjusted on the basis of later information.

The SCS, Economic Research Service (ERS), and Forest Service (USFS) participated in the USDA study. Participation of each agency was coordinated through the Washington Advisory Committee (WAC) and the Field Advisory Committee (FAC). The latter met on the call of the Chairman to effect coordination of USDA studies and to assure that studies were adequately coordinated with studies of other cooperating agencies.

Field examination scope studies, preliminary investigation scope studies, and reimbursable studies for the U. S. Army Engineers were conducted. All studies were oriented toward the individual tributary watershed. Field examination scope studies were developed early in the study to produce a preliminary appraisal of potential project feasibility. Results of the studies were summarized for all watersheds within a tributary basin in preliminary reports, which were provided to cooperating agencies. Preliminary investigation scope studies were made in selected watersheds. These consisted of more intensive studies of

specific projects, the installation of which will need to be initiated within the next 10-15 years. Watershed problems were defined, the nature of the project described, and the cost and benefits of the proposed project were developed, based on data for specific watersheds. Allocation of project costs to project purposes was included. Potential projects were coordinated with projects of other agencies insofar as coordination could be effected.

Investigational efforts were largely confined to the physical and economic relationships within the Study Area. The availability of land for development purposes was indicated by its projected use in the absence of development. The land-taking impact of development was indicated by the changes in the pattern of land use induced by resource development. An intensive study and evaluation was made of the satisfaction of demands for outdoor recreation opportunities in the rural sector, and of levels and efficiency of crops and pasture production. Evaluations were based in part on materials developed and provided by cooperating agencies.

Preliminary examinations were made of the forest resource in selected watersheds and forest cover conditions in selected problem areas were sampled. These studies were combined with a general reconnaissance of all forest lands in the Study Area. Woodland and plant managers, key State and Federal personnel, and officials of private organizations having a primary interest in the forest resources collaborated in the studies. Background information for this study, and other specific information used to correlate published data, were obtained in cooperation with other agencies.

COOPERATING AGENCIES

Cooperating agencies included the U. S. Army Engineers (USAE); the U. S. Geological Survey (USGS), Bureau of Reclamation (BR), Bureau of Mines (BM), Bureau of Outdoor Recreation (BOR), the Federal Water Pollution Control Administration (FWPCA), and the Bureau of Sport Fisheries and Wildlife (BSF&W) of the U. S. Department of Interior (USDI); the Weather Bureau (USWB) of the U. S. Department of Commerce (USDC); the Public Health Service (PHS) of the U. S. Department of Health, Education, and Welfare (USHEW); and the Federal Power Commission (FPC). State agencies included the Arkansas Soil and Water Conservation Commission, Louisiana Department of Public Works, Oklahoma Water Resources Board, and Texas Water Development Board.

The Study was made under the overall direction of the FCC comprised of a representative from each of the Federal departments and each of the State cooperating agencies. The FCC established subcommittees comprised of representatives designated by cooperating agencies for the purpose of effecting planning coordination. Other agencies represented on subcommittees included the Texas Water Rights Commission, Texas State Health Department, Arkansas State Health Department, Arkansas Game and Fish Commission, Texas Department of Parks and Wildlife, Arkansas Geological Commission, and the Texas Bureau of Economic Geology.

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ACKNOWLEDGEMENTS

Several Federal and State agencies furnished valuable data for developing this Appendix. The field offices of the Soil Conservation Service, Forest Service, and Statistical Reporting Service furnished information relating to soils, land use, agricultural production, land treatment, and land use problems. The Forest Service also furnished information and data on management of National Forests. The basin needs for navigation, flood control, recreation, fish and wildlife, water supply, water quality control, and irrigation that were developed by the U. S. Army Engineers, Bureau of Outdoor Recreation, Bureau of Sport Fisheries and Wildlife, Federal Water Pollution Control Administration, and the Bureau of Reclamation provided essential information for developing a potential plan of water and related land resource development under USDA programs.

The Texas Water Development Board and the Louisiana Department of Public Works facilitated preparation of the USDA potential development plan by providing planning and project data within their states. Federal and State cooperating agency comments on USDA preliminary reports for tributary basins and on USDA upstream watersheds investigation reports were useful for coordination of USDA studies with investigations of cooperating agencies.

DESCRIPTION OF THE STUDY AREA

LOCATION AND SIZE

The total land and water area included in the USDA Comprehensive Study is approximately 29,610 square miles (18,950,272 acres) in parts of Arkansas, Louisiana, Oklahoma, and Texas (figure 1). The Study Area extends from Denison Dam, forming Lake Texoma, to a point near the mouth of Red River in Louisiana. It includes all of the drainage area between these points except for the drainage area of the Ouachita River and Black River and the drainage area of Concordia Parish, Louisiana. Also included in the Study Area are Lower Mississippi River drainage areas that are naturally interrelated with Red River drainage areas.

The Study Area includes all or parts of 60 counties and parishes. Nine counties are in Arkansas, 13 in Oklahoma, 19 in Texas, and 19 parishes are in Louisiana. Twenty-two parishes and counties are entirely within and 38 are partly within the Study Area.

GEOLOGY

A relatively small area in the extreme northwestern part of the Study Area lies within the Arbuckle uplift region. Hard limestones, sandstones, shales, and crystalline igneous rocks of Paleozoic and Precambrian ages are represented. The granitic soils in this area are light colored and medium to coarse textured.

Formations in the Ouachita Province represent rocks ranging in age from the lower Paleozoic Era to the Mesozoic Era. Deformation with accompanying induration has added to their resistance to weathering. Metamorphism was not of a significant magnitude to change the nature of all rocks, but there are some quartzites and slates. Rocks of the Ouachita Province, in order of their abundance are shale and slate, sandstone and quartzite, chert, novaculite, tuff, limestone, and conglomerate. Soils developed from the varied types of parent material range from sandy loams to silty clays and clay.

From the Trinity sandstone of Cretaceous age, which is exposed near Denison Dam, the Red River Valley traverses younger formations ranging upward through the Tertiary and Quaternary Periods to Recent age in the West Gulf Coastal Plain. Much of the material in these formations was derived from older sedimentary rocks, and is therefore regarded as reworked material. All the common varieties of sedimentary rocks are contained in Cretaceous and Tertiary formations of the region and impart certain prominent characteristics to the Red River sediments. The usually bright red color is very noticeable. The coloring matter is obtained partly from the Pennsylvanian and Permian rocks farther west, but the amount of ferruginous sediment is increased considerably in Louisiana by the addition of iron oxides from Tertiary formations which contain iron bearing minerals such as glauconite, limonite, hematite, magnetite, and ilmenite. The high mica content of the Midway silts, sands, and clays is

notable, and their color is typically higher than that of later Tertiary groups. Above the Tertiary System, Pleistocene Terraces and Recent alluvium are composed of gravels, sands, clays, and silts and are in contact with present river alluvium. The gravels of the region are mostly chert, quartz, and iron oxides.

TOPOGRAPHY

The terrain in the tributary basins draining into Red River ranges from rugged mountains to low, rolling hills. Elevations range from approximately 40 feet above sea level in Avoyelles Parish, Louisiana, to more than 2,600 feet in southwestern Arkansas. The Ouachita Mountains in Arkansas and Oklahoma have steep slopes, sometimes towering 1,000 feet above narrow valleys. Local areas may have narrow floodplains and one or two stream terraces ranging from 40 to 80 feet above the large channels.

Lands adjoining the Ouachita Mountains on the west are characterized by wide valleys bounded by abrupt escarpments. Generally, the streams flow in broad, shallow channels.

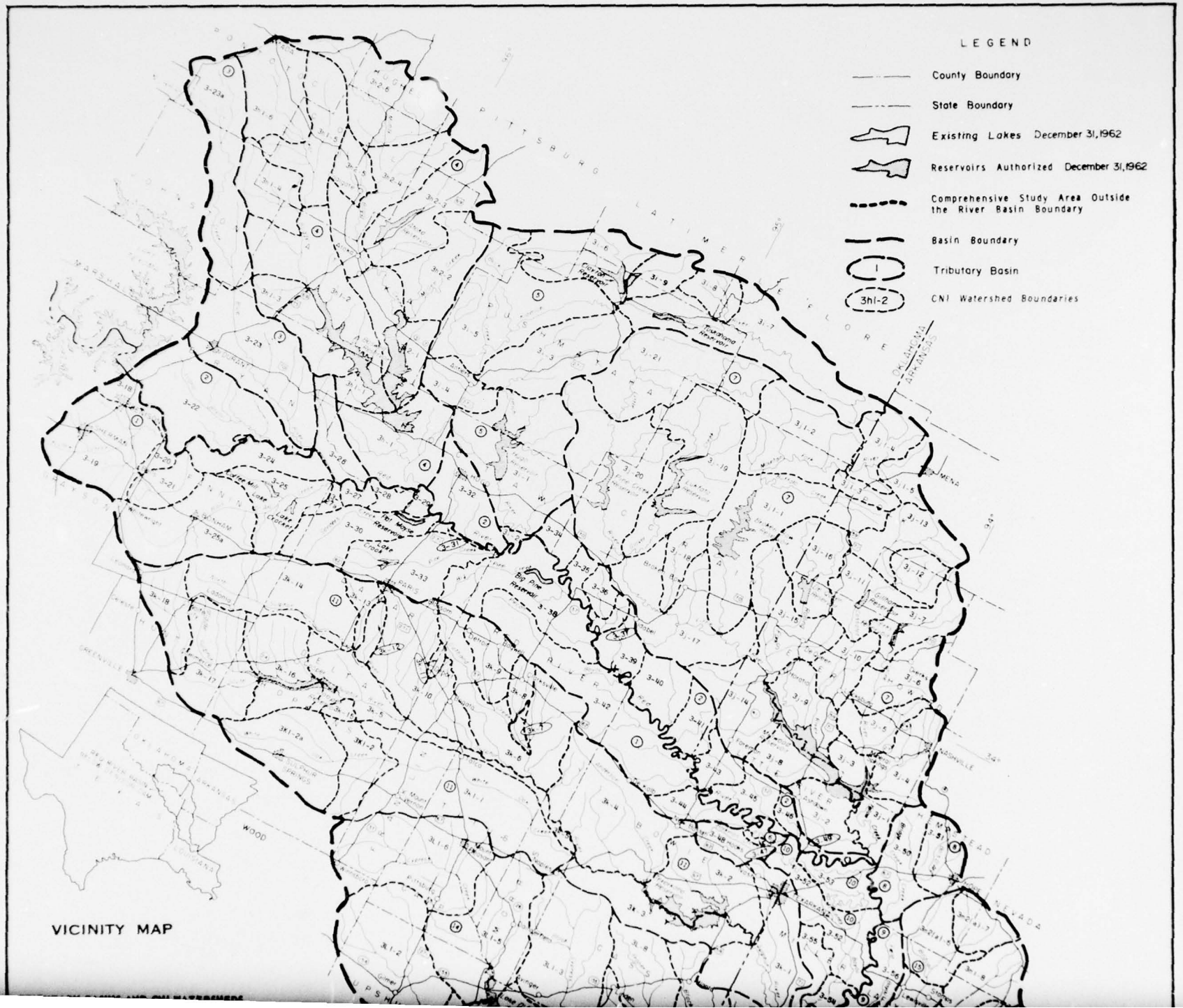
In the tributary basins below the Ouachita Mountains, low relief and gentle southeastward slopes predominate. Irregular, rolling, and hilly uplands associated with relatively flat terraces and floodplains are common topographic expressions. Generally, relief is low, averaging from 100 to 200 feet, except in the Ouachita Mountains.

The elevation of the alluvial land along the main stem of Red River ranges from less than 40 feet above sea level near the mouth of Red River to more than 500 feet near Denison Dam. The valley gradient is steeper above southwestern Arkansas with accompanying slight changes in local relief. Low terraces, or second bottoms, become more common upstream, attaining a relief of 10 to 15 feet in comparison with first bottom alluvium near Denison Dam. In the Arkansas-Louisiana portion of the floodplain, local relief is small; a few isolated low ridges or hills constitute the sharpest breaks in the relatively flat terrain. Depressions resulting from abandoned stream channels are common. Generally, the land slopes gently away from the natural levee adjacent to the river channel.

STREAMS AND LAKES

The Red River, which is the main stem of the drainage system, enters the Study Area at Denison Dam and flows generally southeasterly 470 miles to its confluence with Old River. The river channel is from 700 to 1,200 feet wide, between high banks ranging from 15 to 35 or 40 feet above low water, except for occasional short reaches where the channel lies against the high escarpments that border the alluvial plain in local areas. The floodplain, eight to ten miles wide in general, narrows to about two miles near Denison Dam. Below Alexandria the floodplain becomes integral with the alluvial valley of the Mississippi River. Numerous tributaries enter the Red River below Denison Dam.

Major tributary streams in the Study Area are Boggy Creek, Kiamichi River, Little River, Sulphur River, Twelve Mile Bayou, Loggy Bayou


LEGEND
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VICINITY MAP

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3m2(a)-6 Little Bodcau Creek
3m2(a)-7 Bodcau Creek

16 - Bayou Pierre

3n-1 Jims River
3n-2 Johnson Chute
3n-3 Bayou Dupont
3n-4 Bayou Pierre Laterals
3n-5 Wallace Bayou

17 - Black and Saline Lakes

3o-1 Saline Bayou Laterals
3o-2 Lower Saline Bayou
3o-3 Upper Saline Bayou
3o1-1 Black and Clear Lake Laterals
3o1-2 Grand Bayou
3o1-3 Black Lake Bayou Laterals
3o1-4 Upper Black Lake Bayou

18 - Nantachie Creek

3-63 Nantachie Creek

19 - Cane River

3-64 Bayou Provencal
3-65 Cane River
3-66 Cocodrie and Little River
3-67 *Carnahan Creek*

20 - Bayou Jean de Jean

3-68 Bayou Jean de Jean

21 - Bayou Rapides

10-17 Bayou Rapides
10-18 Bertrand Bayou

22 - Bayou Rigolette

3-69 Bayou DuGrappe
3-70 Bayou Rigolette

23 - Red River Backwater

3-72 Big Creek
3-73 Vick to Saline Bayou
3-74 Muddy Bayou
3-75 Jonesville to Larto Lake
3-76 Saline Bayou to Black River
3-77 West Laterals of Old River
3-78 Old River and Little River Lakes
3-81 Bayou Natchitoches

24 - Chatlin Lake and Associated Area

10-6 Pomme de Terre
10-10 *Waukasha-Courtableau*

3j-10 Lower Cossatot River
3j-11 **Middle Cossatot River**
3j-12 Harris Creek
3j-13 Upper Cossatot River
3j-14 Caney-Flat Creek
3j-15 Lower Rolling Fork
3j-16 Upper Rolling Fork
3j-17 Lower Little River
3j-18 Lukfata Creek
3j-19 Glover Creek
3j-20 Middle Little River
3j-21 Upper Little River
3j1-1 Lower Mountain Fork
3j1-2 Middle Mountain Fork
3j1-3 Cove-Hatfield
3j1-4 Upper Mountain Fork
3j1-5 Potter

8 - Bois d'Arc Creek
3-50 Bridge Creek
3-51 Bois d'Arc Creek

9 - Maniece Bayou
3-56 Maniece Bayou

10 - McKinney Bayou
3-52 Upper McKinney Bayou
3-53 Buzzard Bluff
3-54 McKinney Bayou
3-55 Beech Creek

11 - Sulphur River
3k-1 Lower Sulphur River
3k-2 Big Creek
3k-3 Lower Sulphur Laterals
3k-4 Anderson Creek
3k-5 South Sulphur Laterals
3k-6 Cuthand Creek
3k-7 Sand Branch
3k-8 Langford Creek
3k-9 Bruton Creek
3k-10 Sand-Mustang Laterals
3k-11 Deport Area
3k-12 Click Creek
3k-13 Auds Creek
3k-14 Upper North Sulphur River
3k-15 Morgan Creek
3k-16 South Sulphur
3k-17 South Sulphur River, Middle Sulphur River & Pecan Creek
3k-18 Upper South Sulphur River
3k1-1 Lower White Oak Bayou
3k1-2 White Oak Laterals
3k1-2a White Oak Bayou

12 - Posten Bayou
3-57 Posten Bayou
3-57a Lower Posten Bayou

13 - Red River Main Stem
3-58 Holm Lake
3-59 Sunny Point and Half Moon Lake
3-60 East Point
3-61 Bull Lake and Sims Bayou
3-62 St. Maurice and Dunn Lakes
3-71 Wiggins Bayou

3o-3 **Upper Saline Bayou**
3o1-1 **Black and Clear Lake Laterals**
3o1-2 Grand Bayou
3o1-3 Black Lake Bayou Laterals
3o1-4 Upper Black Lake Bayou

18 - Nantachie Creek
3-63 Nantachie Creek

19 - Cane River
3-64 Bayou Provencal
3-65 Cane River
3-66 Cocodrie and Little River
3-67 Carnahan Creek

20 - Bayou Jean de Jean
3-68 Bayou Jean de Jean

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24 - Chatlin Lake and Associated Area
10-6 Pomme de Terre
10-10 Waukasha-Courtableau
10-11 Bayou Grand Louis
10-12 Bayou Cocodrie
10-13 Bayou Rouge
10-14 Bayou Des Glaises
10-15 Bayou Boeuf
10-16 Chatlin Lake
10-19 Upper Bayou Cocodrie

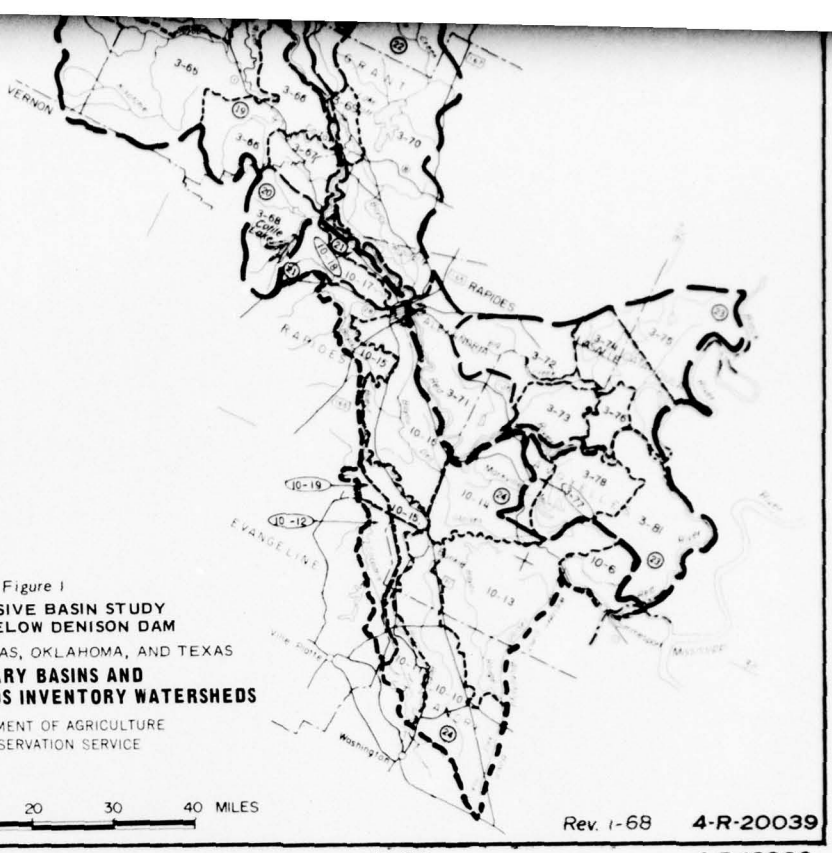

Figure 1

COMPREHENSIVE BASIN STUDY
RED RIVER BELOW DENISON DAM

LOUISIANA, ARKANSAS, OKLAHOMA, AND TEXAS

TRIBUTARY BASINS AND CONSERVATION NEEDS INVENTORY WATERSHEDS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

10 0 10 20 30 40 MILES

Rev. 1-68 4-R-20039

OKLAHOMA PORTION COMPILED FROM USGS 1:500,000 BASE - REMAINDER FROM AMS 1:250,000 SHEETS
EXISTING LAKES FROM ABOVE SOURCES SUPPLEMENTED WITH USGS QUADRANGLES AND COUNTY HIGHWAY MAPS.

USDA SCS FORT WORTH, TEX. 1968

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Bayou Pierre, and Saline Bayou. These tributary streams flow directly into the main stem of Red River and have drainage areas ranging from 1,138 square miles to 4,231 square miles.

Minor tributaries, too numerous to identify, enter Red River at points scattered throughout its length. Generally, tributaries in the upper reaches of Red River are fast, freely flowing streams; tributaries in the lower reaches are slow, congested streams.

Numerous natural lakes, such as river cutoffs and tributary streams with silt plugs in their drainage outlets, exist in and adjacent to the Red River floodplain. Federal and State agencies have increased the storage in some of the natural tributary lakes to provide water for recreation and navigation. For example, Caddo Lake was improved by the USAE in 1914 to provide for a navigation pool at an elevation of 168.5 feet mean sea level. The lake covers an area of 20,900 acres. This area also provides varied recreation facilities. Bistineau, Black, and Clear Lakes are other natural lakes improved by the Louisiana Department of Public Works to provide increased recreation opportunities.

Several major reservoirs providing flood control, water supply, and other beneficial uses are either completed or under construction by the USAE. Millwood Reservoir on Little River and Lake Texarkana on Sulphur River are the largest of these reservoirs with storage capacities of 1,858,000 and 2,654,300 acre-feet, respectively.

Other smaller lakes have been built by Federal, State, or private groups for multiple uses. The SCS, under the authority of Public Law 566, has built many floodwater retarding structures on tributary streams.

TRIBUTARY BASINS AND CONSERVATION NEEDS INVENTORY WATERSHEDS

The Study Area was subdivided into 24 tributary basins ranging in size from 73 to 4,231 square miles. Tributary basin names, numbers, and locations are shown in Figure 1 and areal data are tabulated in Table 1.

Each of the tributary basins is essentially an independent hydrologic unit consisting of one or more smaller hydrologic units. The hydrologic units within the tributary basin are referred to as Conservation Needs Inventory (CNI) watersheds. Each watershed is identified by name and code designation (figure 1).

LAND AND WATER AREAS

Land and water areas were based on data developed for the 1958 National Inventory of Soil and Water Conservation Needs and adjusted to reflect conditions existing in 1962. The 1958 Inventory was prepared by the Conservation Needs Committee in each of the four states. Basic areal data were developed for parishes and counties for the National inventory. These data were used for parishes and counties lying wholly within the Study Area. For parishes and counties that are not wholly in the Study Area, acreages were planimetered and coordinated with acreages of

Table 1 - Tributary Basin Areas, Red River Basin Study Area

Tributary Basin	Total Land and Water Area	
	acres	square miles
Intervening Areas - Texas	1,352,773	2,114
Barkman Creek	46,700	73
McKinney Bayou	246,088	385
Sulphur River	2,377,736	3,715
Cypress Creek	2,308,043	3,606
Blue River	433,751	678
Intervening Areas - Ark. and Oklahoma	759,371	1,187
Boggy Creek	1,546,617	2,417
Kiamichi River	1,176,923	1,839
Little River	2,707,621	4,231
Bois d'Arc Creek	154,108	241
Maniece Bayou	73,818	115
Posten Bayou	89,050	139
Loggy Bayou	1,716,675	2,682
Bayou Pierre	762,820	1,192
Cane River	484,439	757
Bayou Jean de Jean	58,494	91
Bayou Rapides	52,979	83
Black & Saline Lakes	888,609	1,388
Nantachie Creek	54,071	84
Bayou Rigolette	267,370	418
Red River Backwater Area	486,954	760
Chatlin Lake and Associated Area	598,543	936
Red River Main Stem 1/	306,719	479
Total	18,950,272	29,610

1/ Main Stem Tributary Basin is confined to Louisiana

adjacent river basins. Distribution of land and water resources, rounded to the nearest 100 acres, is shown by states in Table 2.

About 29.3 percent of the Study Area is in Texas, 28.2 percent is in Louisiana, 27.2 percent is in Oklahoma, and the remaining 15.3 percent is in Arkansas. The large water area includes permanent water surfaces such as lakes, reservoirs, and ponds having 40 acres or more of surface area

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Table 2 - Land and Water Areas by States, Red River Basin Study Area, 1962

State	Land Area	Large Water Area	Total Land and Water Area
	thousand acres		
Arkansas	2,853.2	41.7	2,894.9
Louisiana	5,208.9	132.1	5,341.0
Oklahoma	5,111.0	51.0	5,162.0
Texas	5,487.9	64.5	5,552.4
Total	18,661.0	289.3	18,950.3

and streams, sloughs, and canals one-eighth of a statue mile or more in width, and islands within large water areas that are less than 40 acres in size. Large water areas comprise approximately 1.5 percent of the total area. About 45.7 percent of the large water area is in Louisiana, 22.3 percent is in Texas, 17.6 percent is in Oklahoma, and 14.4 percent is in Arkansas.

The land area was subdivided into Inventory and Noninventory areas for purposes of the USDA investigations. The Noninventory acreage includes urban and built-up areas, land owned by the Federal Government other than agricultural land operated under lease or permit, and small water areas consisting of bodies of water less than 40 acres in size (mostly farm ponds) and streams less than one-eighth of a mile wide. The Inventory acreage includes the remaining land area. Distribution of Inventory and Noninventory land areas by states is shown in Table 3.

Table 3 - Inventory and Noninventory Areas by States, Red River Basin Study Area, 1962

State	Inventory Area	Noninventory Area	Total Land Area
	-thousand acres		
Arkansas	2,660.7	192.5	2,853.2
Louisiana	4,627.7	581.2	5,208.9
Oklahoma	4,879.8	231.2	5,111.0
Texas	5,165.1	322.8	5,487.9
Total	17,333.3	1,327.7	18,661.0

Of the 1,327,700 acres in the Noninventory Area, about 52 percent is Federal land. Federal land consists principally of National Forests and Defense Department lands. About 80 percent of all the Federal land produces timber products for regional markets. All National Forests and

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about 50 percent of the Defense Department land (USAE reservoir areas) are managed for a wide variety of recreational use by the general public.

Urban and built-up areas constitute about 42 percent of the Noninventory acreage. These include cities, villages, and other built-up areas of more than 10 acres, industrial sites, roads, railroads and railroad yards, cemeteries, airports, golf courses, shooting ranges, and similar developments.

Small water areas include about six percent of the Noninventory acreage. Noninventory area composition is shown in Table 4.

Table 4 - Noninventory Area Land Use Distribution by States, Red River Basin Study Area, 1962

Land Use	Arkansas	Louisiana	Oklahoma	Texas	Total
	- - - - - - - - - - - - thousand acres - - - - - - - - - -
Federal land	107.0	332.7	139.9	114.5	694.1
Forest land	107.0	316.6	136.9	99.8	660.2
Other	-	16.1	3.0	14.7	33.9
Urban & built-up	71.4	213.3	78.7	189.2	552.6
Small water areas	14.1	35.2	12.6	19.1	81.0
Total	192.5	581.2	231.2	322.8	1,327.7

LAND RESOURCES

Farming Regions

More than 500 type-of-farming areas and 400 subtypes have been outlined in the United States. There are, however, 10 major farming regions. They differ in soils, slope of land, climate, distance to market, and in storage and marketing facilities. Over the years, the general types of farming best suited to each region have developed, although traditional crops may be less important now.

The four states in the Red River Basin Comprehensive Study (below Denison Dam) are located in two of the 10 regions. Arkansas and Louisiana are a part of the Delta Region and Texas and Oklahoma are part of the Southern Plains Region.

Trends for these two regions as they relate to their production as a percent of United States production, 1939-63, and projected to 1980, are presented in Exhibit 1. These statistical trends served as guidelines for more detailed analyses of the agricultural sector in the Study Area. This exhibit material shows that it is within primarily agricultural regions

that functional changes are occurring in agriculture. 1/

Land Capability Classes

All soils in the Inventory acreage were classified according to their potentialities and limitations for sustained agricultural and forestry production. All soils of the Study Area are included in seven land capability classes. The risk of soil damage or limitations in use becomes progressively greater from Class I to Class VII. Soils in the first four classes are capable of producing, under good management, adapted plants such as trees or range plants, and the common cultivated field crops and pasture plants. Soils in the last three classes are best suited to the production of native vegetation. Some soils in Classes V and VI also are capable of producing specialized crops, such as certain fruits, ornamentals, field crops, and vegetable crops, under highly intensive management involving elaborate soil and water conservation practices.

Class I - Soils in this class have few limitations that restrict their use.

Class II - Soils in this class have some limitations that reduce the choice of plants or require moderate conservation practices.

Class III - Soils in this class have severe limitations that reduce the choice of plants or require special conservation practices, or both.

Class IV - Soils in this class have very severe limitations that restrict the choice of plants and require very careful management.

Class V - Soils in this class have little or no erosion hazard, but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland and forest, or wildlife habitat.

Class VI - Soils in this class have severe limitations that make them generally unsuited for cultivation and limit their use largely to pasture or range, woodland and forest, or wildlife habitat.

1/ Talk by W. B. Sundquist, FPED, at the 44th Annual Agricultural Outlook Conference, Washington, D. C., November 15, 1966

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Class VII - Soils in this class have very severe limitations that make them unsuited for cultivation and that restrict their use largely to grazing, woodland and forest, or wildlife habitat.

All the Inventory acreage was classified except minor areas of some miscellaneous uses, such as farmsteads, roads, and cemeteries. Land capability class distribution is shown in Table 5 by major land resource areas. Table 5 also shows distribution of inventory and noninventory areas by major land resource areas. Approximately 62 percent of the inventory acreage is capable of producing the common cultivated field crops.

Table 5 - Major Land Resource Area Distribution and Land Capability Classes by Major Land Resource Areas, Red River Basin Study Area, 1962

Major Land Resource Area and Numerical Designation	Inventory Area, Land Capability Class I	II	III	IV	V	VI	VII	Unclassified	Total Inventory	Non-Inventory Area	Total Land Area
	thousand acres										
Southern Mississippi Valley Silty Uplands 134	1.1	72.9	24.5	-	3.4	-	8.2	-	110.1	3.9	114.0
Southern Mississippi Valley Alluvium 131	391.8	562.8	721.5	1.0	723.0	0.1	-	1.7	2,401.9	122.4	2,524.3
Southern Coastal Plain 133	180.6	1,731.4	3,067.8	1,489.2	1,139.7	686.5	613.2	30.4	8,938.8	834.7	9,773.5
Texas Blackland Prairie 86	29.1	573.6	617.8	132.7	298.9	16.4	113.4	3.9	1,785.8	83.1	1,868.9
Grand Prairie 85	47.5	146.6	137.8	34.6	42.9	93.5	196.4	-	699.3	20.1	719.4
Cross Timbers 84 & 84a	5.9	27.9	45.7	12.5	6.6	40.5	69.3	1.3	209.7	14.2	223.9
Cherokee Prairies 112	5.4	82.0	114.4	46.2	79.2	45.3	73.5	-	446.0	22.5	468.5
Ouachita Mountains 119	14.2	72.7	209.2	153.4	177.6	243.3	1,851.5	2.2	2,724.1	226.3	2,950.4
Central Rolling Red Prairies 80	9.7	1.7	-	2.1	-	4.1	-	-	17.6	0.5	18.1
Total	685.3	3,271.6	4,938.7	1,871.7	2,471.3	1,129.7	2,925.5	39.5	17,333.3	1,327.7	18,661.0

Source: 1958 National Inventory of Soil and Water Conservation Needs adjusted to 1962 conditions

Land Resource Areas

The range in climatic and soil conditions within the Study Area has resulted in distinctive patterns of agriculture and land use. Geographical areas of land, at least several thousand acres in extent, characterized by a particular combination of pattern of soils, including slope and erosion, climate, water resources, land use, and types of farming called land resource areas, have been delineated as shown on Figure 2. A land resource area may occur in one continuous area, or in discontinuous segments. Figure 2 shows locational distribution of land resource areas. Table 6 shows for each land resource area the acreages within the Study Area by the four states and the percent of the total land area occupied by each land resource area.

Southern Mississippi Valley Silty Uplands (134)

This LRA includes 114,000 acres in Louisiana. This is a gently rolling, generally well-drained area. Soils are developed from loessial materials. The vegetation is mainly pine with an understory of hardwood trees. A high proportion of this forested area has been cleared and used for cropland and pasture.

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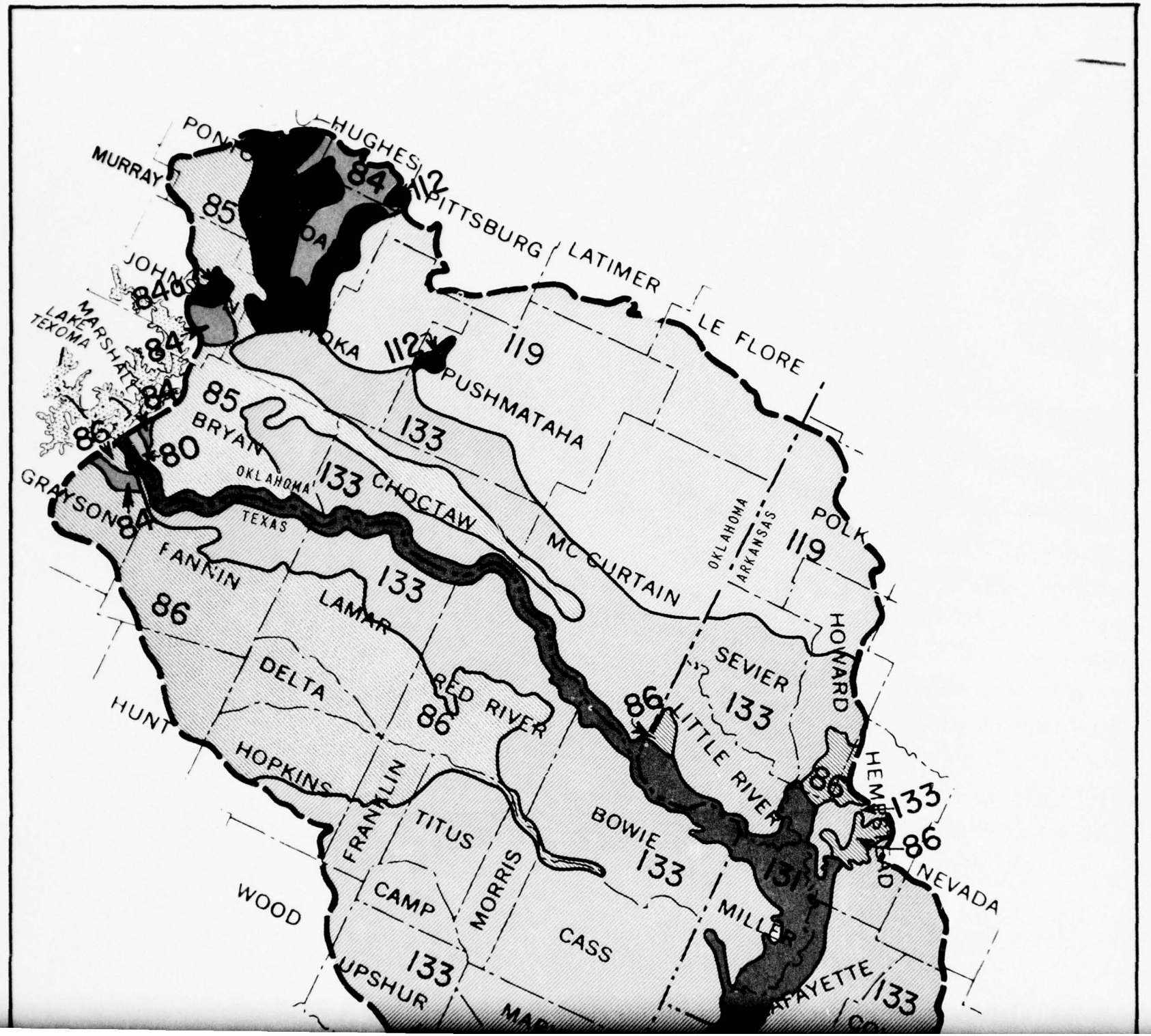
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LE FLORE
MURRAY
JOHNSTON
MARSHALL
LAKE TEXOMA
PUSHMATAHA
BRYAN
OKLAHOMA
TEXAS
CHOCTAW
MC CURTAIN
OKLAHOMA
ARKANSAS
POLK
GRAYSON
FANNIN
LAMAR
RED RIVER
DELTA
HUNT
HOPKINS
FRANKLIN
TITUS
MORRIS
CAMP
WOOD
CASS
BOWIE
LITTLE RIVER
SEVIER
HOWARD
MILLER
HEMPSTEAD
NEVADA
LAFAYETTE
UPSHUR
84
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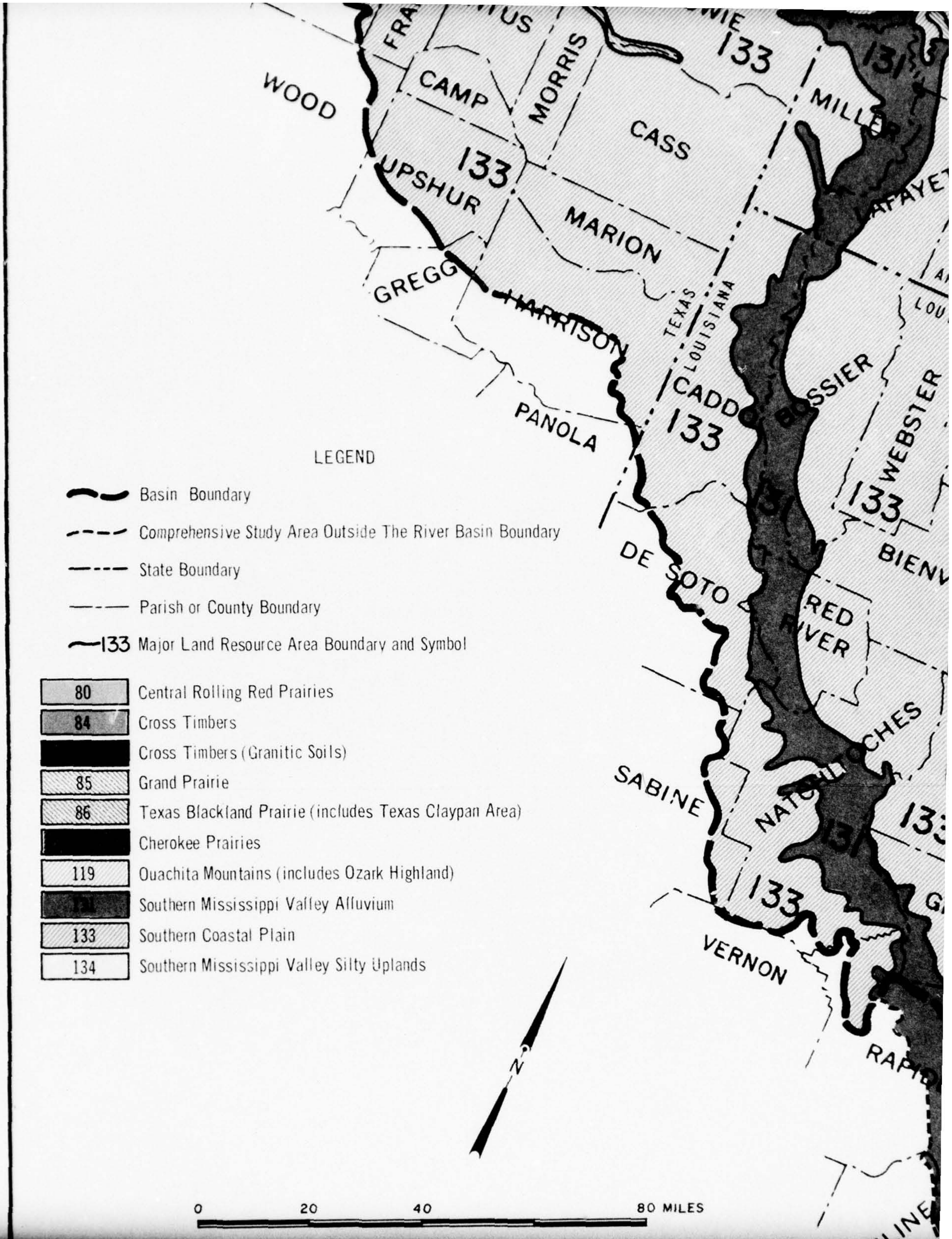
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MORRIS
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MILLER
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UPSHUR
MARION
GREGG
HARRISON
TEXAS
LOUISIANA
CADDO
BOSSIER
WEBSTER
PANOLA
DE SOTO
RED RIVER
BIENV
SABINE
NATCHITOCHES
VERNON
RAPIDES
131
LEGEND
Basin Boundary
Comprehensive Study Area Outside The River Basin Boundary
State Boundary
Parish or County Boundary
133 Major Land Resource Area Boundary and Symbol
80 Central Rolling Red Prairies
84 Cross Timbers
Cross Timbers (Granitic Soils)
85 Grand Prairie
86 Texas Blackland Prairie (includes Texas Claypan Area)
Cherokee Prairies
119 Ouachita Mountains (includes Ozark Highland)
131 Southern Mississippi Valley Alluvium
133 Southern Coastal Plain
134 Southern Mississippi Valley Silty Uplands
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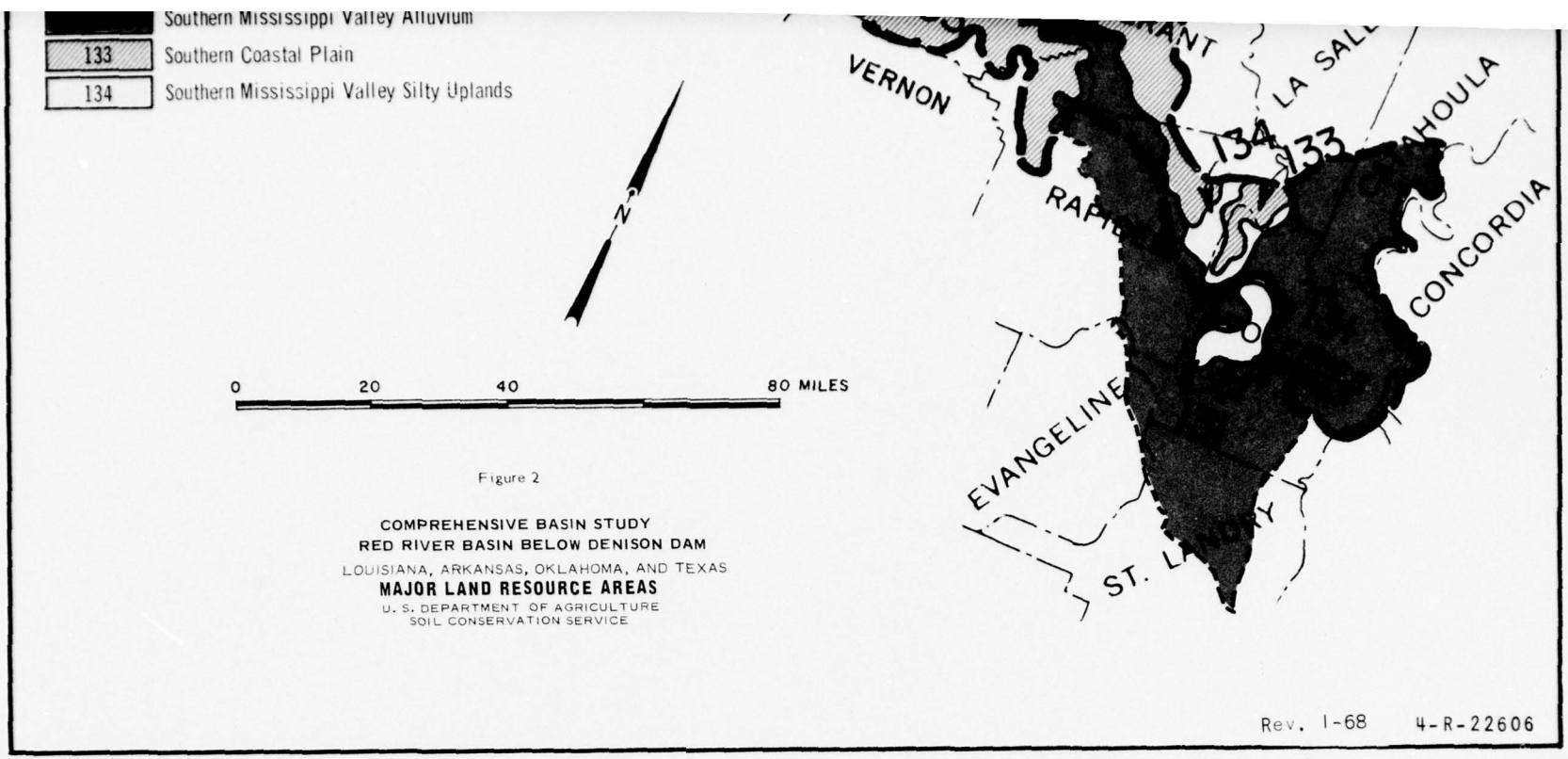

Figure 2

COMPREHENSIVE BASIN STUDY
RED RIVER BASIN BELOW DENISON DAM
LOUISIANA, ARKANSAS, OKLAHOMA, AND TEXAS
MAJOR LAND RESOURCE AREAS
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Rev. 1-68 4-R-22606

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Table 6 - Major Land Resource Areas by States, Red River Basin Study Area, 1962

Major Land Resource Area and Numerical Designation	Arkansas	Louisiana	Oklahoma	Texas	Land Area	Percent of Total Land Area
	thousand acres					
Southern Mississippi Valley Silty Uplands 134	-	114.0	-	-	114.0	0.6
Southern Mississippi Valley Alluvium 131	370.5	1,821.5	155.6	176.7	2,524.3	13.6
Southern Coastal Plain 133	1,842.2	3,273.4	1,160.6	3,497.3	9,773.5	52.4
Texas Blackland Prairie 86	110.6	-	-	1,758.3	1,868.9	10.0
Grand Prairie 85	-	-	719.4	-	719.4	3.8
Cross Timbers 84 and 84a	-	-	168.3	55.6	223.9	1.2
Cherokee Prairies 112	-	-	468.5	-	468.5	2.5
Ouachita Mountains 119	529.9	-	2,420.5	-	2,950.4	15.8
Central Rolling Red Prairies 80	-	-	18.1	-	18.1	0.1
Total	2,853.2	5,208.9	5,111.0	5,487.9	18,661.0	100.0

Southern Mississippi Valley Alluvium (131)

Red River and intermingled Lower Mississippi River Alluvial soils are included in this LRA. This includes 2,524,300 acres in the four states from the mouth of Red River to Denison Dam. The surface relief is subdued and slopes generally to the south and east. Areas of undulating or dissected topography occur where overflows are frequent. The LRA is sometimes divided into first bottoms which may overflow frequently and the higher elevation terraces which seldom overflow. The native vegetation is mainly hardwood trees. However, because of the high inherent fertility and favorable topography, most of the hardwoods have been cleared where flood hazards and drainage problems have been surmounted.

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Cropland in the Southern Mississippi Valley Silty Uplands

Southern Mississippi Valley Alluvium - Avoyelles Parish, Louisiana

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Southern Coastal Plain (133)

The Southern Coastal Plain is the largest LRA in the Study Area. It occupies 9,773,500 acres and occurs in each of the four states. This is a gently rolling to hilly, well-dissected, mostly well-drained area, although some flat areas on stream divides and in stream floodplain areas have poor drainage. The vegetation in the eastern part is mainly pine trees with an understory of hardwood trees; mainly oak, gum, elm, and some hickory. In the western part, locally called the Post Oak Belt, the vegetation is mainly hardwood trees; mostly post oak, blackjack, and elm, with some pine.

Southern Coastal Plain - Webster Parish, Louisiana

A high proportion of this forested area has been cleared and used for cropland at one time or another over a long period of years. Because of depleted fertility and soil loss by erosion, much of this once-cultivated land has been reforested, either by natural reseeding or by planting. Some is now used for pasture. The soils, if well-managed, are suited for growing a wide variety of field crops, special and truck crops, and vine and tree fruit.

Texas Blackland Prairie (86)

Surface relief of LRA 86 is generally undulating to gently rolling, although it ranges from nearly level on some watershed divides to strongly

Texas Blackland Prairie - Fannin County, Texas

sloping in areas bordering stream valleys. It includes 1,868,900 acres in Texas and Arkansas. The native vegetation consists primarily of bunch and short grasses. A subarea of the Texas Blackland Prairie LRA known as the "Graylands" occurs in Texas as a transition zone between the Southern Coastal Plain and this LRA.

The soils of the Texas Blackland Prairie LRA, as a whole, are among the most productive upland soils of the Study Area. However, because of the clay texture and sloping surfaces, they are very susceptible to erosion. Many areas have been severely eroded, and some of the steeper slopes are so gullied that they are no longer suited for cultivation.

Grand Prairie (85)

This LRA includes 719,400 acres in Oklahoma. It includes rocky rangeland on steep slopes, as well as deep, agriculturally productive land on undulating to gently sloping topography. The climax vegetation is primarily mid and tall grasses. In many areas, scrubby, woody vegetation is an invader.

Cross Timbers and Granitic Soils (84 and 84a)

This LRA comprises 223,900 acres of land in Texas and Oklahoma. Native vegetation and soils are similar to the Post Oak Belt of the

Grand Prairie Rangeland

Grand Prairie Crop and Pasture Land

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Cross Timbers - Bryan County, Oklahoma

Southern Coastal Plain LRA, except for the small area of Granitic soils in Johnston County, Oklahoma. The Granitic soils are developed from pre-Cambrian granites and occur on bouldery, tree-covered slopes with prairie grasses on some of the ridges. Inherent soil fertility is low and relatively small areas have been cleared for cultivation.

Cherokee Prairies (112)

The LRA includes 468,500 acres of land area in Oklahoma. The climax vegetation consists primarily of mid and tall grasses. Climax vegetation in most of the area succumbed to the plow. Soils are developed from sandstones and shales and are agriculturally productive. Topography is generally undulating to gently sloping.

Ouachita Mountains (119)

LRA 119 includes an area of 2,950,400 acres in Arkansas and Oklahoma. It is a forested area of great natural beauty. Topography is rolling to steep. Soils are developed from sandstones, shale, and chert, and are generally too shallow for cultivation. Agriculture is important to the area only in the relatively narrow valleys and in local areas of deeper soil development. The climax vegetation is mainly pine trees with an understory of hardwood trees; mainly oak, elm, and hickory. A relatively small amount of Ozark Highland, which is an area of rough hills formed by the dissection of a cherty plateau, is interspersed with this land resource area.

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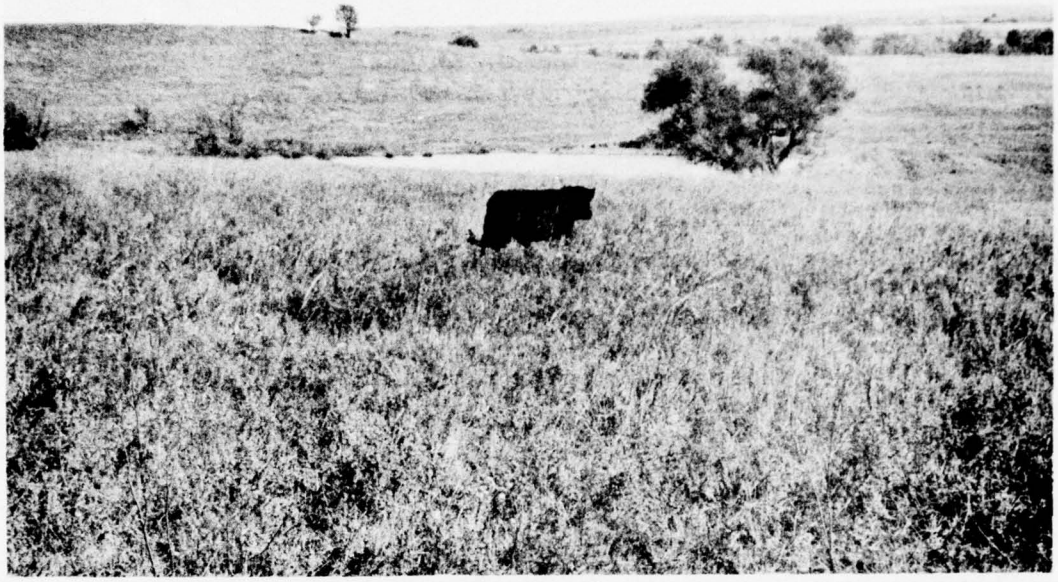

Cherokee Prairies - Pontotoc County, Oklahoma

Ouachita Mountains - McCurtain County, Oklahoma

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Central Rolling Red Prairies (80)

The LRA extends into the Study Area in Oklahoma. It occupies only 18,100 acres and occurs as a high terrace of the Red River. Slopes are gently sloping and soils are deep. Native vegetation consists of hardwood trees.

Major Land Use

Major land use distributions were developed for the Inventory Area of the land resource base. This area of 17,333,300 acres (table 3) is the primary agricultural and forestry land resource base. Major land use distribution by the nine land resource areas is shown in Table 7. The proportion that each major land use occupies of the total land area also is shown in this table.

Table 7 - Distribution of Inventory and Noninventory Areas by Major Land Resource Areas and Major Land Uses of the Inventory Area, Red River Basin Study Area, 1962

Major Land Resource Area and Numerical Designation	Inventory Area					Noninventory Area	Total Land Area
	Cropland	Pasture Range	Forest Woodland	Miscellaneous Land	Total Inventory Area		
	thousand acres						
Southern Mississippi Valley Silty Uplands 134	19.8	38.7	50.0	1.6	110.1	3.9	114.0
Southern Mississippi Valley Alluvium 131	718.0	531.0	1,104.3	48.6	2,401.9	122.4	2,524.3
Southern Coastal Plain 133	1,350.1	1,383.8	6,003.3	201.6	8,938.8	834.7	9,773.5
Texas Blackland Prairie 86	965.8	491.4	301.4	27.2	1,785.8	83.1	1,868.9
Grand Prairie 85	164.5	337.0	157.8	40.0	699.3	20.1	719.4
Cross Timbers 84 and 84a	26.5	38.1	112.9	32.2	209.7	14.2	223.9
Cherokee Prairies 112	71.8	193.5	119.5	61.2	446.0	22.5	468.5
Ouachita Mountains 119	56.5	147.4	2,436.9	83.3	2,724.1	226.3	2,950.4
Central Rolling Red Prairies 80	16.1	-	0.3	1.2	17.6	0.5	18.1
Total	3,389.1	3,160.9	10,286.4	496.9	17,333.3	1,327.7	18,661.0
Percent of total land area	18.2	16.9	55.1	2.6	92.8	7.2	100.0

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About 35 percent of the land is used for cropland and pasture and/or range. Slightly over 55 percent is in forest woodland. Miscellaneous land which includes farmsteads, farm roads, levees, and other miscellaneous rural uses involves less than three percent. Noninventoried areas, or urban land, public roads, and other public land ownership, also are shown in Table 7. These lands amount to approximately seven percent of the total land area.

Significant characteristics pertaining to land use, crop distribution, and land capability subclasses are summarized in subsequent tables. Areal data as it relates to major agricultural land uses, the four basin states, and land resource areas are presented in Exhibits 2 and 3.

FOREST RESOURCES

General Description

Of the 18,661,600 acres of land in the Red River Basin Study Area, 10,946,600 acres 1/, or 58.6 percent, were forest land in 1962. This forest cover varies from lush oak-gum-cypress stands on the floodplain of the lower Red River to the relatively thin stands of upland oaks and hickories in the uppermost reaches of the Study Area in Oklahoma and Texas. Pines, red oaks, white oaks, red gums, and hickories are predominant on the extensive upland forest areas of intervening tributary basins, with relatively small areas of a variety of bottomland species found along the floodplains and low terraces of the tributary streams.

The Forest Timber Types Map, Figure 3, shows the distribution and extent of forest cover types. The development of natural forest cover is dependent on overall climate, the physical and chemical character of the soil, topography and other natural features, and cultural factors induced by man's occupancy and increasing heavy use of the land. The amount and distribution of rainfall and inherent fertility of the soil are the most important influences, with precipitation (as soil moisture available to plants) being the ultimate limiting factor. Generally, species that occupy a forest site are those that grow most vigorously under the combination of the above factors that exist on the site.

In 1962, the different lands in the Grand Prairie, Central Rolling Red Prairies, Cross Timbers, and Granitic Soils land resource areas were not producing commercial timber in saleable quantities. These areas lie in the uppermost reaches of the basin and the normal rainfall will not usually support good growth in commercial species. In 1962, the bulk of the commercial forest lands were found in the Southern Mississippi Valley Alluvium and Silty Uplands, Southern Coastal Plain, and Ouachita Mountains LRAs.

1/ Includes inventoried and noninventoried forest land

Commercial Forest Land

For 1962, Forest Surveys 1/ in Arkansas, Louisiana, Oklahoma, and Texas show 10,180,600 acres of commercial 2/ forest land in the Red River Basin Study Area. According to these studies, 93 percent of the total forest land area in the basin is commercial forest land. Table 8 gives the commercial forest acreage in the different timber types and their prevalence in the basin. Figure 3 shows the geographical distribution of timber types and the extent of commercial forest land.

Seventy-eight percent of the commercial forest area supports essentially upland forest types. Pine and hardwood-pine types occupy almost two-thirds of the upland area. The remaining upland forest area, generally located along the northern and western perimeter of the basin, supports the oak-hickory type.

The elm-ash-cottonwood and oak-gum-cypress types are bottomland forest types and comprise 22 percent of the total commercial forest area.

Forty percent of the commercial forest area bears sawtimber stands, 27 percent bears poletimber stands, 31 percent bears seedlings and saplings, and the remaining two percent is nonstocked. Table 9 shows the commercial forest area by forest types and stands sizes.

Forest Land Ownership

In 1962, about 93 percent of the Study Area's commercial forest land was privately owned and seven percent was publicly owned. Distribution by ownership classes was as follows: farm ownership, 20 percent; forest industry, 23 percent; other private ownership, 50 percent; National Forest, four percent; other Federal ownership, two percent; and State, county, or municipal ownership, one percent. Table 10 shows commercial forest land area by ownership class, by States. Table 11 shows, by ownership class, the 1962 volume of growing stock and sawtimber on commercial forest lands.

Since 1962, the National Forests have acquired an additional 11,000 acres within the Study Area. This additional acreage was acquired for present and future recreation needs. The 55-mile Talimena Scenic Drive and recreation complex in LeFlore County, Oklahoma, and Polk County, Arkansas, is under construction (1966) on some 3,000 acres acquired since 1962. As of 1966, only minor changes in National Forest acreage can be foreseen. These minor changes will occur through planned acquisition of key tracts needed for future recreation needs and tracts within critical

---

1/ Arkansas Forest Survey of 1959, Louisiana Forest Survey of 1954 and 1964, Oklahoma Forest Survey of 1956, and Texas Forest Survey of 1955 and 1965 by Southern Forest Experiment Station, USFS. Data used was adjusted to 1962 levels by field sampling in 1964-1966.

2/ Commercial forest land, as used in this report, is forest land that is producing or is capable of producing crops of industrial wood and has not been withdrawn from timber production.

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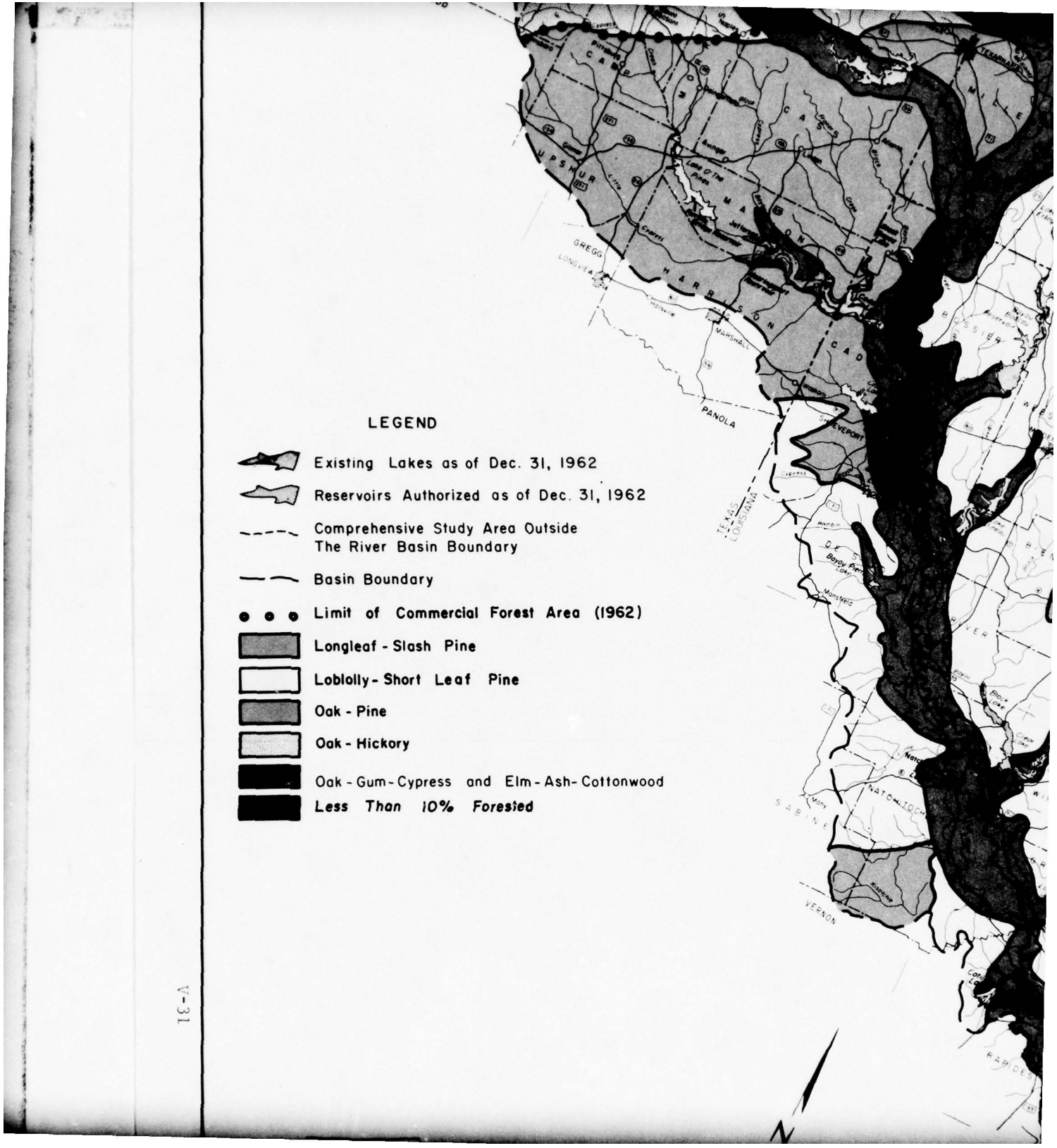
PITTSBURG
LATIMER
LE FLORE
OKLAHOMA
ARKANSAS
MARSHALL
JOHNSTON
COAL
HUGO
Coffee Mill Lake
Lake Crook
Big Pine Reservoir
Broken Bow
Idabel
Gillham Reservoir
De Queen
MENA
PARIS
GREENVILLE
SULPHUR SPRINGS
WOOD
Pittsburg
CAMP
CASS
MILLER
TEXARKANA
HOWARD
NEVADA
LAFAYETTE
UPSHUR


LEGEND
Existing Lakes as of Dec. 31, 1962
Reservoirs Authorized as of Dec. 31, 1962
Comprehensive Study Area Outside The River Basin Boundary
Basin Boundary
Limit of Commercial Forest Area (1962)
Longleaf - Slash Pine
Loblolly - Short Leaf Pine
Oak - Pine
Oak - Hickory
Oak - Gum - Cypress and Elm - Ash - Cottonwood
Less Than 10% Foresied
CAMP
UPSHUR
MARION
HARRISON
GREGG
PANOLA
MARSHALL
SHREVEPORT
TEXAS
LOUISIANA
NATCHITOCH
VERNON
SABINE

VICINITY MAP

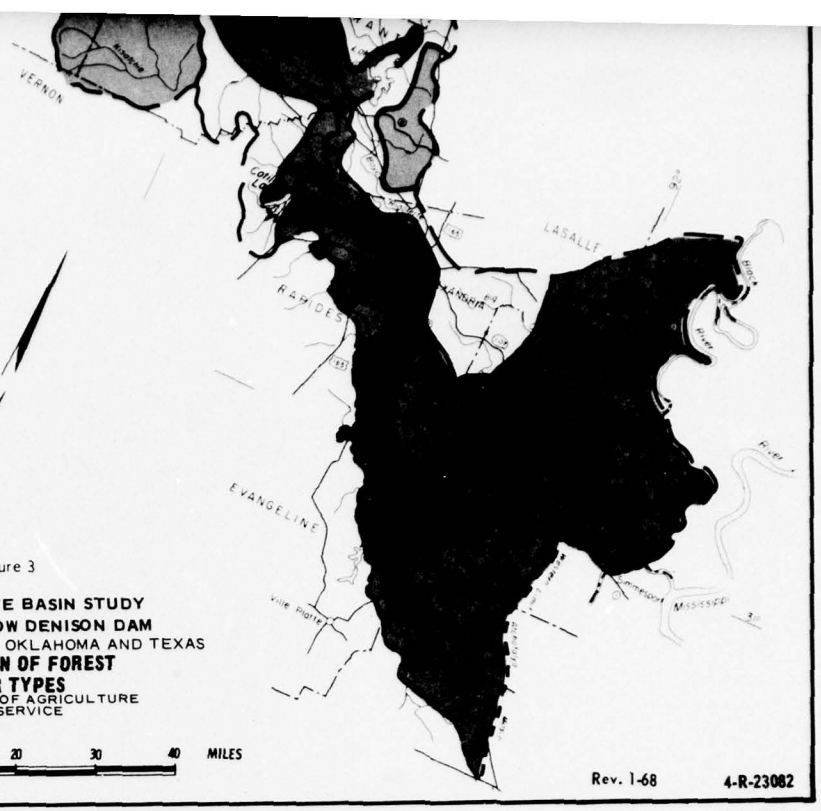


Figure 3

COMPREHENSIVE BASIN STUDY
RED RIVER BELOW DENISON DAM
LOUISIANA, ARKANSAS, OKLAHOMA AND TEXAS
DISTRIBUTION OF FOREST TIMBER TYPES
U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

10 0 10 20 30 40 MILES

Rev. 1-68 4-R-23082

BASE MAP COMPILED BY U.S.D.A., SOIL CONSERVATION SERVICE, FORT WORTH, TEXAS, FROM U.S.G.S. 1:500,000 BASE AND AMS 1:250,000 MAPS.

USDA-SCS-FORT WORTH, TEX. 1968

Rev. 1-68 4-R-18830

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Table 8 - Distribution of Commercial Forest Area by Forest Types 1/, Red River Basin Study Area, 1962

Forest Type	Area	
	thousand acres	percent
Softwood types		
Longleaf-slash pine	128.9	1
Loblolly-shortleaf pine	3,502.4	34
Oak - pine	1,504.3	15
Total	5,135.6	50
Hardwood types		
Oak - hickory	2,858.7	28
Elm - ash - cottonwood	203.8	2
Oak - gum - cypress	1,982.5	20
Total	5,045.0	50
All Types	10,180.6	100

Source: State Forest Survey Reports, Southern Forest Experiment Station, U. S. Forest Service

1/ Definitions of forest types as used in this report are as follows:
Longleaf-slash pine. These species, singly or in combination, make up 50 percent or more of the forest stand. Other southern pines, oak, and gum are common associates.
Loblolly-shortleaf pine. These species, singly or in combination, or other southern yellow pines except longleaf or slash pine, compose 50 percent or more of the forest stand. Oak, hickory, and gum are common associates.
Oak-pine. Fifty percent or more of the stand is hardwood, usually upland oaks and 25-49 percent is southern pine. Gum, hickory, and yellow-poplar are common associates.
Oak-hickory. Upland oak and hickories, singly or in combination, make up 50 percent or more of the forest stand except where pines are present and compose 25 to 49 percent of the stand. Under the latter conditions, the stand is classified as oak-pine. Yellow poplar, elm, maple, and black walnut are common associates.
Elm-ash-cottonwood. These species, singly or in combination, make up 50 percent or more of the forest stand. Willow, sycamore, beech, and maple are common associates.
Oak-gum-cypress. Bottomland forests where tupelo, black gum, sweetgum, oaks, or southern cypress, singly or in combination, make up 50 percent or more of the stand. Where pines are present and compose 25-49 percent, the stand is classified as oak-pine types. Cottonwood, willow, ash-elm, hackberry, and maple are common associates.

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A virgin loblolly pine stand, reserved for a scenic area on National Forest lands near Saline Lake in Winn, Parish, Louisiana. This stand contains an average of 30,000 board feet per acre. (U. S. Forest Service Photo)

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Table 9 - Area of Commercial Forest Land by Forest Type and Stand Size Classes, Red River Basin Study Area, 1962

Forest Type	All Stand Sizes	Saw-timber	Pole-timber	Seedlings and Saplings	Nonstock and Other Areas
			thousand acres		
Softwood types					
Longleaf-slash pine	128.9	58.7	23.0	47.0	0.2
Loblolly-shortleaf pine	3,502.4	1,791.7	835.7	851.6	23.4
Oak-pine	1,504.3	474.3	412.2	611.9	5.9
Total	5,135.6	2,324.7	1,270.9	1,510.5	29.5
Hardwood types					
Oak-hickory	2,858.7	487.3	1,028.9	1,274.1	68.4
Elm-ash-cottonwood	203.8	88.0	42.7	65.8	7.3
Oak-gum-cypress	1,982.5	1,200.3	449.6	276.1	56.5
Total	5,045.0	1,775.6	1,521.2	1,616.0	132.2
Total all types	10,180.6	4,100.3	2,792.1	3,126.5	161.7

Source: State Forest Survey Reports, Southern Forest Experiment Station, U. S. Forest Service

watersheds that will consolidate National Forest lands. Additional consolidation of National Forest lands for improved efficiency in management is planned through land exchanges with private landowners.

Table 10 - Area of Commercial Forest Land by States and Ownership Classes, Red River Basin Study Area

State	All Ownerships	Public Ownership				Private Ownership			
		Total	National Forest	Other Federal	Other Public	Total	Farm	Forest Industry	Other Private
				thousand acres					
Arkansas	2,022.2	120.2	105.8	1.2	13.2	1,902.0	513.9	581.6	806.5
Louisiana	3,513.9	329.9	242.4	74.2	13.3	3,184.0	344.7	631.5	2,207.8
Oklahoma	2,828.2	170.4	120.4	16.5	33.5	2,657.8	628.6	936.5	1,092.7
Texas	1,816.3	105.7	0.0	99.7	6.0	1,710.6	528.2	151.6	1,030.8
Total	10,180.6	726.2	468.6	191.6	66.0	9,454.4	2,015.4	2,301.2	5,137.8

Source: See Table 9

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Table 11 - Volume of Growing Stock and Sawtimber on Commercial Forest Land by Ownership and Species Group, Red River Basin Study Area, 1962

Ownership	Volume of Growing Stock			Volume of Sawtimber		
	Softwoods	Hardwoods	Total	Softwoods	Hardwoods	Total
	million cubic feet			million board feet		
Public						
National forest	318.8	91.2	410.0	1,477.7	214.8	1,692.5
Other Federal	64.5	63.0	127.5	294.3	175.4	469.7
Other public	18.2	7.3	25.5	34.6	54.3	88.9
Subtotal public	401.5	161.5	563.0	1,806.6	444.5	2,251.1
Private						
Farm	295.1	532.1	827.2	1,098.0	1,245.1	2,343.1
Forest industry	1,226.6	506.4	1,733.0	5,546.7	1,427.4	6,974.1
Other private	1,166.8	1,376.7	2,543.5	4,657.4	4,048.9	8,706.3
Subtotal private	2,688.5	2,415.2	5,103.7	11,302.1	6,721.4	18,023.5
All Ownership	3,090.0	2,576.7	5,666.7	13,108.7	7,165.9	20,274.6

Source: State Forest Survey Reports, Southern Forest Experiment Station, U. S. Forest Service

Forest Land, Timber Inventories, and Volumes, By States

In 1962, the distribution of commercial forests by States was as follows: Arkansas, 19.9 percent, Louisiana, 34.5 percent; Oklahoma, 27.8 percent; and Texas, 17.8 percent. Table 12 shows the 1962 distribution of growing stock and sawtimber volumes in the Study Area by States. The inventory represented in the table is far too little to utilize the full growth potential of the commercial forest lands available in each state. This condition in the overall timber inventory is caused by accumulation of cull trees and competing vegetation on many acres of poorly managed forest lands.

Many timber stands on commercially productive forest land have become submarginal in merchantability due to the build-up of low-quality trees and low-value species. This condition is most apparent in mixed and pure hardwood stands.

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Table 12 - Volume of Growing Stock and Sawtimber on Commercial Forest Lands by Species Groups in States, Red River Basin Study Area, 1962

States	Volume					
	Growing Stock			Sawtimber		
	Softwoods	Hardwoods	Total	Softwoods	Hardwoods	Total
	million cubic feet			million board feet		
Arkansas	769.1	516.3	1,285.4	3,473.7	1,216.6	4,690.3
Louisiana	1,517.4	1,086.7	2,604.1	6,699.8	3,530.2	10,230.0
Oklahoma	423.0	455.3	878.3	1,723.5	1,102.1	2,825.6
Texas	380.5	518.4	898.9	1,211.7	1,317.0	2,528.7
Basin	3,090.0	2,576.7	5,666.7	13,108.7	7,165.9	20,274.6

Source: State Forest Survey Reports, Southern Forest Experiment Station, U. S. Forest Service

The 1962 inventory of timber volumes by states, on an average per acre basis is shown in Table 13. The difference in magnitude of this average data is not a direct indication of the average management levels in the different state areas. Considerable variation is attributable to the inherent productivity of the forest soils and climate of the areas involved. The level and viability of local and regional timber markets have a direct effect on average management levels and prevailing stand conditions.

Table 13- Average Volume Per Acre of Growing Stock and Sawtimber on Commercial Forest Land by States and Species Groups, Red River Basin Study Area, 1962

States	Volume per acre					
	Growing Stock			Sawtimber 1/		
	Softwoods	Hardwoods	Total	Softwoods	Hardwoods	Total
	cubic feet			board feet		
Arkansas	380	256	636	1,718	602	2,320
Louisiana	414	296	710	1,906	1,004	2,910
Oklahoma	143	168	311	611	390	1,000
Texas	209	286	495	612	778	1,390
Basin Average	304	253	557	1,287	704	1,991

Source: State Forest Survey Reports, Southern Forest Experiment Station, U. S. Forest Service

1/ Board foot volume is included in cubic foot growing stock volume

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WATER RESOURCES

Appendix Report III describes in detail the quantities and qualities of both surface water and ground water in the Study Area. Only a cursory treatment of this subject is given in this report.

Surface Water Supply

The average annual runoff of tributary basins ranges from eight inches in Bryan County, Oklahoma, to 20 inches in Polk County, Arkansas. Near Alexandria, Louisiana, the average annual runoff is approximately 15 inches.

Total annual streamflow in the tributary basins varies greatly from year to year. In the Blue River Basin of the Bryan County area, the highest flow was equivalent to about 28 inches; and the lowest flow was equivalent to about one inch. In the Nantachie Creek Basin near Alexandria, Louisiana, the highest flow was equivalent to about 36 inches; and the lowest annual flow was equivalent to about two inches.

The diagrams in Figures 4 and 5 show variations in streamflow for drainage areas selected as representative of variations to be expected in upper and lower parts of the Study Area. Figure 4 shows the year-to-year variations in annual flow and Figure 5 shows average variations in monthly flow.

Existing and authorized Federal water projects through 1962 contain approximately 2.9 million acre-feet of storage for all purposes. An additional 0.6 million acre-feet is available from state, municipal, and private reservoirs. Of the total 3.5 million acre-feet available, approximately 1.6 million acre-feet are for municipal and industrial uses.

Water in Red River is poor quality for all uses because of the high natural salt content. Generally speaking, water in tributary streams is better quality than Red River water and is suitable for municipal and many industrial uses with little treatment.

Ground Water Supply

Large supplies of ground water are available in parts of the Sulphur River and Cypress Creek basins and along the main stem of Red River in Texas. The greatest potential for ground water development is in the southeastern part of the area, which is underlain by thick sections of water-bearing sands. These strata may yield as much as 500 g.p.m. (gallons per minute) to individual wells that range in depth from about 100 to 800 feet.

Supplies of ground water are also available in the northwestern part of this area. However, because the depth to most of the aquifers is more than 1,200 feet, development has been slow.

Alluvial deposits along the Red River in Arkansas, Louisiana, and Texas and in the lower reaches of Sulphur River and Cypress Creek are

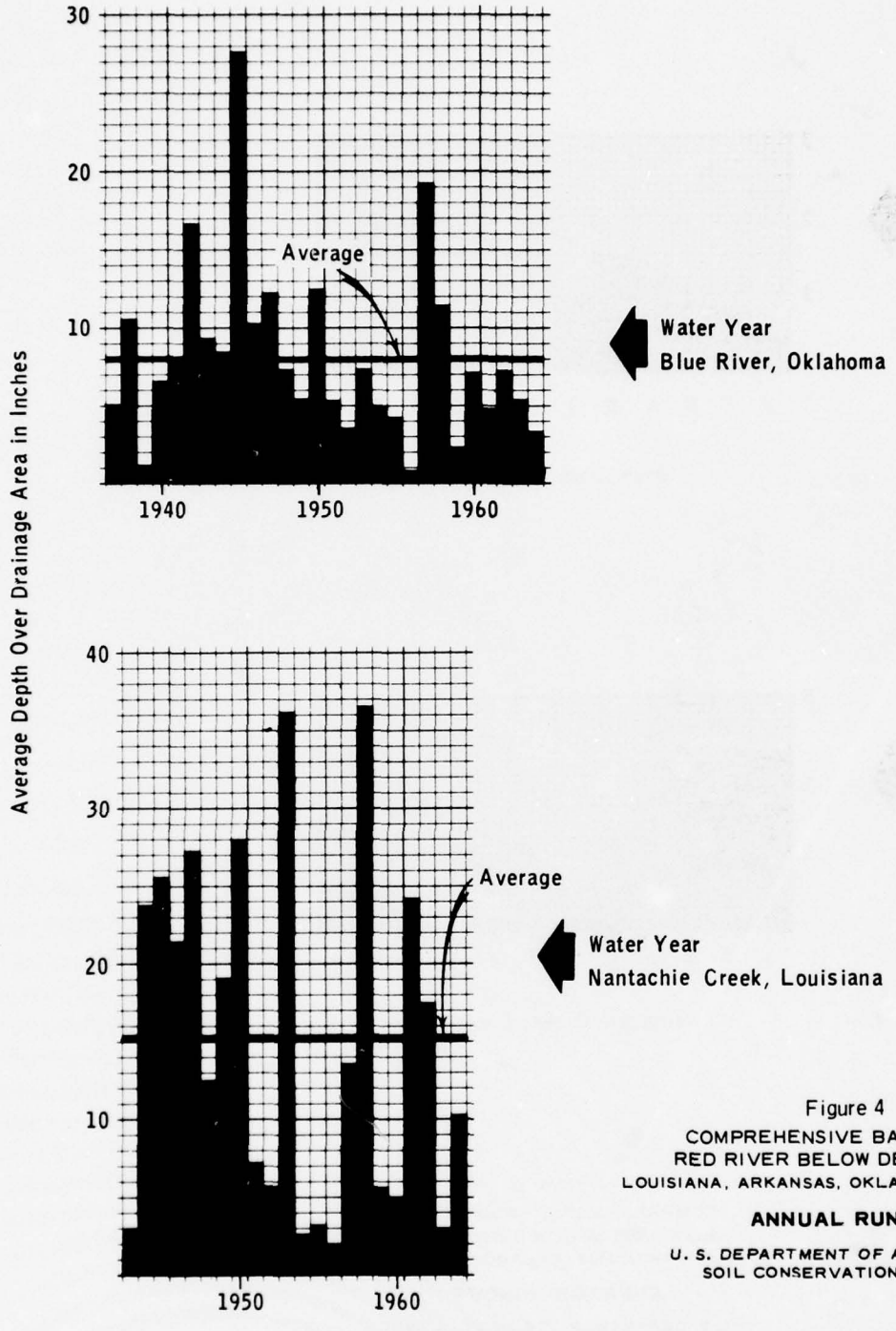

Figure 4

COMPREHENSIVE BASIN STUDY
RED RIVER BELOW DENISON DAM
LOUISIANA, ARKANSAS, OKLAHOMA, AND TEXAS

ANNUAL RUNOFF

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

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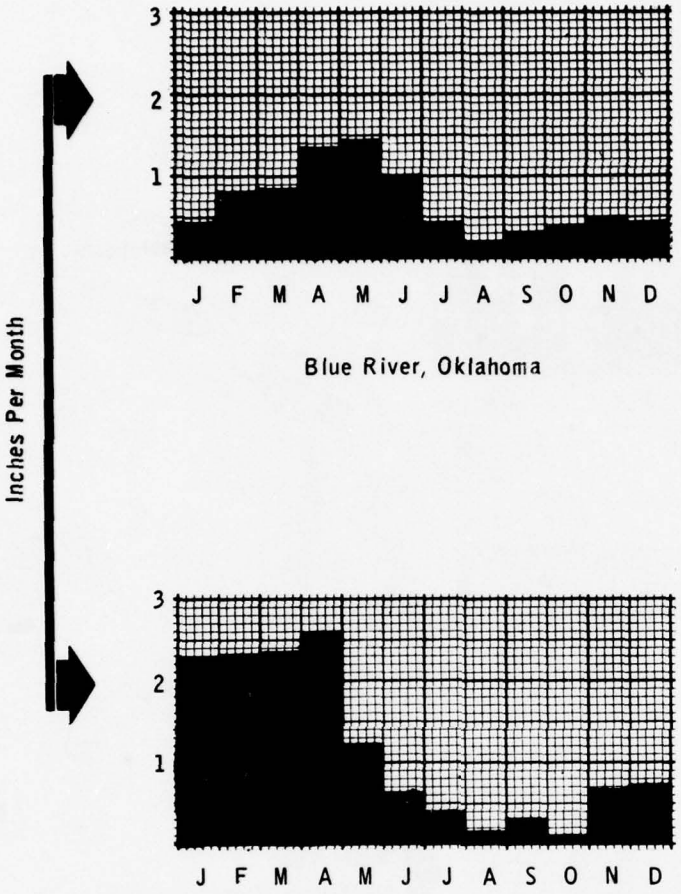

Figure 5

COMPREHENSIVE BASIN STUDY
RED RIVER BELOW DENISON DAM
LOUISIANA, ARKANSAS, OKLAHOMA, AND TEXAS

AVERAGE RUNOFF

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

USDA-SCS-FORT WORTH, TEX. 1967

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capable of yielding large supplies of ground water. The depth of wells in the alluvium generally is less than 125 feet and yields range from 500 g.p.m. in Texas to 1,700 g.p.m. in Louisiana.

The principal sources of ground water, in estimated decreasing order of potential, are as follows:

1. Terrace and alluvial deposits in the Red River Valley in Louisiana, Arkansas, and Texas.

2. Sand belts of the Wilcox Group and the Carrizo Sand which underlie the area south of a line through Sulphur Springs and Texarkana.

3. The Trinity Group, Woodbine Formation, Blossom Sand, and Nacatoch Sand which underlie the area north and west of a line through Sulphur Springs and Texarkana.

4. Near surface formations in the upper Sulphur River basin along White Oak Creek from Cooper to Bogota, Texas, and northeastward in the vicinity of New Boston, Texas; and in the Cypress Creek Basin in Caddo Parish, Louisiana.

Abundant supplies of ground water are available for development in only a few parts of Blue River, Boggy Creek, Kiamichi River, and Little River Tributary Basins. The greatest potential lies in the lower reaches of the basins which are underlain by sediments of the Southern Coastal Plain, and in the limestone formations of the Arbuckle Mountains in the upper Blue River Basin. The sandstone and shales, which underlie nearly all of the upper river basins, are capable of producing only limited quantities of variable-quality water. Therefore, there appears to be little potential for extensive development of ground water in a large portion of the upper river basins.

The principal sources of ground water, by aquifers in decreasing order of potential development, are as follows:

1. The outcrop of the Paluxy Sand, which extends east to west across the lower basins and southward where it dips under younger rocks. Wells yield from 50 to 500 g.p.m. from depths less than 150 feet.

2. Terrace and alluvial deposits along the lower reaches of all the rivers, especially Little River and along the Red River. Well depths in the alluvium range from 25 to 80 feet and yield up to 500 g.p.m. Well depths in terrace deposits range from 100 to 800 feet and yield 50 to more than 500 g.p.m.

3. Limestone formations in the Arbuckle Mountains. These formations yield water to springs and wells from fractures and solution channels. Wells yield as much as 500 g.p.m. locally from shallow depths, but the strata may be barren

of water at other locations because of the lack of openings.

4. Sandstone and shale strata of the upper river basins in the Arbuckle and Ouachita Mountains. Wells less than 25 feet deep will yield from 10 to 50 g.p.m. intermittently.

In Louisiana, the Red River alluvium ranges in thickness from 75 feet near the Arkansas line to more than 150 feet in Avoyelles Parish. The lower sections are composed of sands and gravels which form an aquifer capable of yielding large quantities of water suitable for irrigation. Wells tapping the alluvial aquifers range in yields from 200 to 1,700 g.p.m. and in depth from 45 to 130 feet.

Older formations are sources of ground water beneath and adjacent to the alluvium along Red River in Louisiana. Pleistocene Terrace deposits yield water from wells ranging from 15 to 130 feet deep. In thick deposits, several hundred thousand gallons per day possibly can be obtained. Yields vary from 100 to 600 g.p.m. Eocene and Miocene deposits produce water from depths ranging from 100 to 1,000 feet. These older sands are typical continental deposits and may pinch out abruptly or grade laterally into clay. Consequently, hydraulic characteristics are reliable for only local areas. Yields range from 250 to 1,200 g.p.m. in these older formations.

Data are insufficient to permit an evaluation of the annual dependable maximum withdrawals available from aquifers. Reconnaissance investigations have been performed by the USGS in Texas, Oklahoma, and Arkansas, and numerous publications are available from state and other agencies which evaluate ground water depths and the yields to wells in gallons per minute; however, little information is available on the amount of water that can be withdrawn annually. Data are available on annual dependable maximum withdrawals available from some formations in the Sulphur River and Cypress Creek Basins. A dependable annual yield of 4,800 acre-feet is available from the Trinity Group, 11,700 acre-feet from the Woodbine Formation, and 18,000 acre-feet from the Carrizo Sand and Wilcox Group, Undifferentiated. The utilization of large amounts of the ground water from these formations is preempted by present municipal and industrial consumers, particularly in Grayson County.

The quality of water is suitable for most uses from practically all of the principal aquifers in the Red River Basin in Texas in the upper zones; however, the chloride content increases with depth. In general, good quality water is available in Oklahoma and Arkansas except in southern McCurtain County, Oklahoma, and southern Little River County, Arkansas, where the water is highly saline.

Generally, water quality is suitable for most uses in Louisiana. A few isolated areas are excepted because of contamination with salt water from underlying formations. One of the larger areas of salt water contamination is at Clarence, in Natchitoches Parish, where the chloride concentration reaches 8,000 parts per million. More detailed information is needed before evaluation of the potential for future development of ground water can be attempted.

ECONOMIC DEVELOPMENT AND ACTIVITY, PRESENT AND PROJECTED

POPULATION

In 1962, the Study Area population was about 1,757,400 or approximately 59 persons per square mile (Exhibit 4). About 49 percent of the people lived in the urban areas of Shreveport, Alexandria, Bossier City, Texarkana, Sherman, and Paris; 40 percent lived in rural towns with populations of 2,500 or less; and 11 percent lived on farms (table 14).

Table 14 - Population Distribution: Urban and Rural, 1930, 1940, 1950, 1960, and 1962; Projection 1/ for 1980 and 2010, extrapolated to 2080, Red River Basin Study Area 2/

Classification	Year							
	1930	1940	1950	1960	1962	1980	2010	2080
	- - - - - - - - - numbers - - - - - - - - -							
Urban	359,517	471,849	636,787	808,923	865,950	1,379,500	2,565,400	8,330,300
Rural	1,348,243	1,413,170	1,102,179	895,254	891,450	857,200	857,700	857,800
Rural, Non-farm	NA	442,954	534,525	687,465	698,570	733,500	772,400	-
Rural, Farm	NA	970,216	567,654	207,789	192,880	123,700	85,300	-
Total	1,707,760	1,885,019	1,738,966	1,704,177	1,757,400	2,236,700	3,423,100	9,188,100

1/ Based on projection of Series B Census of Population, U. S. Department of Commerce
2/ These data represent 9 counties in Arkansas, 19 parishes in Louisiana, 13 counties in Oklahoma, and 19 counties in Texas. Whole county data are presented in this analysis. Census of Population definitions apply.

About 48 percent of the Study Area total population in 1960 was in Louisiana. Major cities in the Louisiana portion of the Study Area were Shreveport, Alexandria, and Bossier City, with populations of 164,372; 40,279; and 32,776, respectively. All other urban places and towns had populations of less than 32,000.

Approximately 30 percent of the Study Area population in the 1960 Census of Population was in the Texas counties. Texarkana, the major city, had a population of 30,218. Sherman and Paris with populations of 24,988 and 20,977 respectively, were the only other sizeable cities.

Oklahoma and Arkansas accounted for 22 percent of the Study Area population in 1960. Texarkana, Arkansas, the major city in this grouping, had a population of 19,788. Magnolia, Arkansas, and Durant, Oklahoma, had populations of 10,651 and 10,467, respectively. All other towns and communities had populations of less than 10,000 each.

The total population of the Study Area increased slightly more than 10 percent from 1930 to 1940. Since 1940, the population of the basin decreased at each Census reporting period (figure 6).

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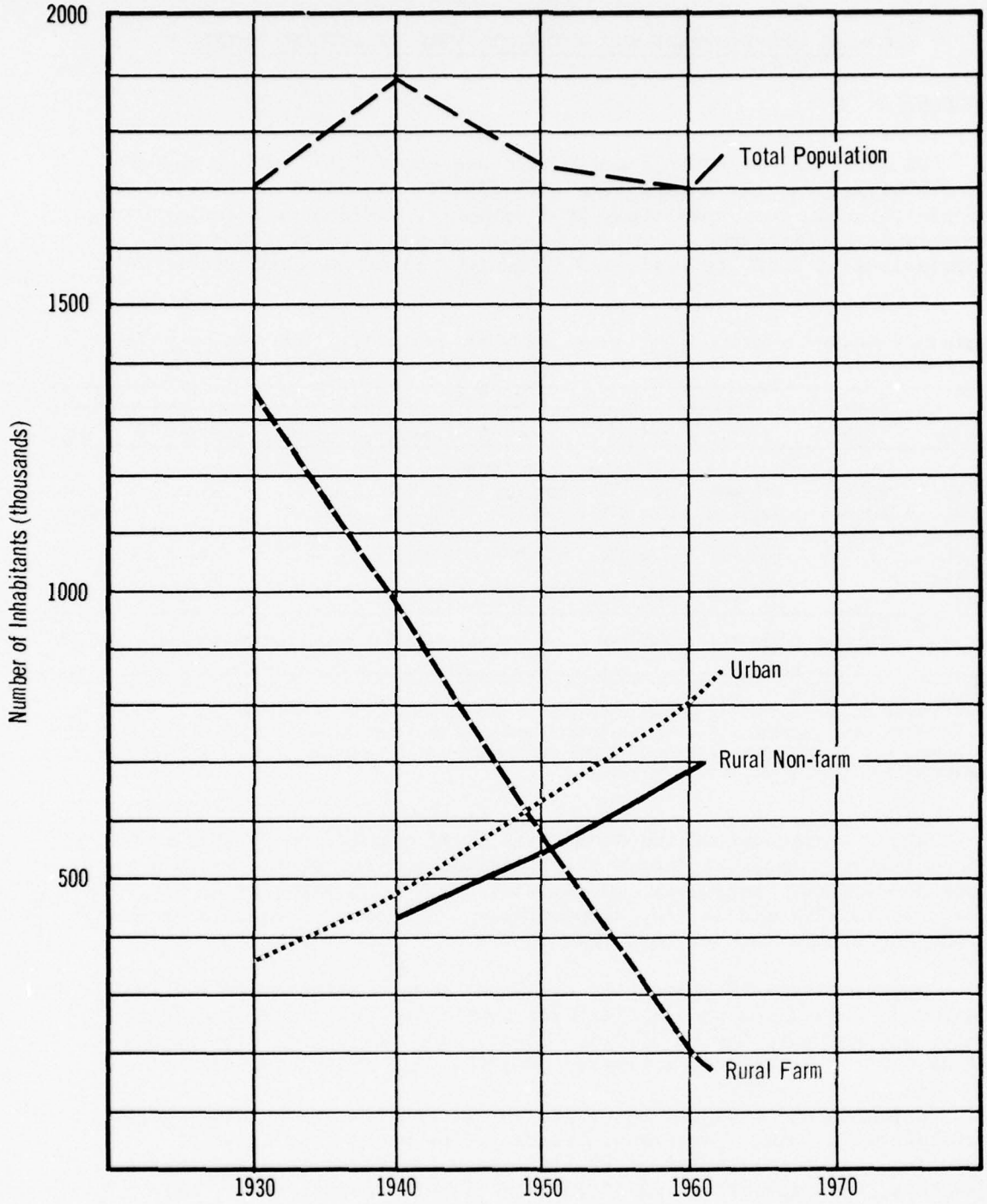

SOURCE: U. S. Census of Population

Figure 6

POPULATION: URBAN, RURAL NON-FARM, RURAL FARM AND TOTAL POPULATION
RED RIVER BASIN STUDY AREA, 1930-1962

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Rural farm population has continually declined since 1930. Expanded farm size resulting from improved technology and mechanization has been the major factor contributing to the decline in rural farm population.

The decline in rural farm population has been offset by an increase in rural non-farm and urban population. The expansion of wood processing (plywood, pulp mills, etc.) and other industries was a major factor contributing to the population relocation.

Changes in the numbers and composition of the Study Area population are indicators of a changing economy. The historic decline in total population may suggest a faltering economy. However, the decline in the past can be related mainly to the rural segment of the economy. The urban and rural non-farm sectors of the economy have been increasing. An internal shift of this type suggests that reorganization of the economy is occurring, and the expected results would be a more prosperous and stable economy. The readjustment, however, is expected to take many years and the decline of the rural farm sector is projected to continue through the year 2010 (table 14).

The projected urban population increase is expected to be concentrated in the presently established metropolitan areas, Shreveport-Bossier City, Alexandria, and Texarkana. By 2010, less than 10 percent of the total rural population will be classified as rural farm. The remaining 90 percent of the rural population will be classified as rural non-farm, or those persons "living outside the cities or other incorporated places having 2,500 inhabitants or more who do not live on farms". The larger proportion of rural farm decline will be in the less productive areas of the basin. After 1980, the total rural population will remain fairly constant at approximately 857,700.

Persons per farm are expected to remain fairly constant after 1962, at about 2.5 persons per farm. The farm population projections can be determined by projected farm numbers and person per farm.

EMPLOYMENT

Labor Force

In 1962, about 724,900 people, or 41 percent of the population in the Study Area, were employed. About 39 percent of the working force were employed in services and government, and 17 percent were employed in wholesale and retail trades. Manufacturing, agriculture, and mining employed 14 percent; 7 percent; and 3 percent, respectively. Seasonal agricultural workers are not included in this figure. Utilities, communications, and transportation and contract construction each employed about 6 percent of the labor force. The remaining 8 percent worked in finance, insurance and real estate, and other industries.

Trends in employment are shown in Table 15. Employment in agriculture has declined since 1940, while employment in manufacturing, services, finance and government services has increased. Percentage increases in employment between 1950 and 1960 were the greatest in other industries, government and armed forces, and finance. Industrial employment increased over 40 percent during the last decade; government and armed forces, and finance employments were up 26 percent and 23 percent, respectively.

Table 15 - Labor Force and Employment Estimates, 1940, 1950, 1960, and 1962, Projected 1980 and 2010, Red River Basin Study Area 1/

Industry	1940	1950	1960	1962	1980	2010
			- numbers -			
Agriculture	212,902	115,069	54,764	52,200	55,000	50,000
Mining	18,820	25,015	20,361	20,300	22,000	34,000
Manufacturing	49,990	78,619	93,379	98,600	128,000	219,000
Utilities, communications, and transportations	32,935	49,315	42,828	44,900	51,000	75,000
Trade	97,629	133,652	122,165	126,800	142,000	235,000
Services	100,570	134,366	161,483	168,200	188,000	308,000
Construction	NA	52,174	44,934	44,900	56,000	87,000
Finance, insurance and real estate	NA	20,012	24,574	26,100	22,000	39,000
Other industries	75,280	20,727	29,488	31,200	18,000	29,000
Government	NA	69,327	82,848	86,300	41,000	48,000
Armed forces	NA	16,439	25,276	25,400	18,000	18,000
Total labor force	588,126	714,715	702,100	724,900	741,000	1,142,000

1/ A refinement of these data is found in the Economic Appendix

With increasing urbanization and a stabilization of agricultural employment opportunities, the labor force participation rates in the Study Area are expected to gradually approach the National level 1/. Agriculture employment is projected to decrease through 1980 and remain fairly constant through 2010. The armed forces projection reflects a basic assumption of no major wars. All other industries are expected to increase in the number employed (table 15).

These estimates of population and employment are based on the current rates of resource development. The anticipated effect of proposed projects and other types of accelerated resource development are not included in these projections.

1/ USAE, New Orleans District. Economic Appendix, Appendix I, New Orleans: 1967

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Farm Employment

The total farm labor force in the Study Area decreased between 1939 and 1949; increased 26 percent from 1949 to 1954; and then decreased more than 50 percent from 1954 to 1959 (table 16). In the 1959 Census of Agriculture, 114,000 people were reported in the total farm labor force. The number of farms reporting farm labor varies widely between "family workers, including the farm operator" and "all hired workers" employed in the farm labor force. It is estimated that approximately 134,400 people were classified in these two categories in 1962.

In 1939, 86 percent of the total farm number was reported as having over 235,500 persons listed as family farm labor. This amounted to 1.5 persons per farm reporting. Since 1939, the number of persons listed as family farm labor has decreased about 60 percent, while the persons per farm reporting remain fairly stable at 1.4.

Hired farm workers include those employed more than 150 days and seasonal workers. In 1939, only 11 percent of the total farms reported hired workers, for a total hired labor force of 43,974. The percentage of farms reporting hired workers has remained fairly stable at 10 percent through 1959. The number of hired workers per farm reporting varies from 1939 to 1962 as indicated in Table 16.

Table 16 - Farm Labor: Family including Operator, and All Hired Workers on Farms Reporting, 1939-1959 Census Periods, and 1962 and Projected to 1980 and 2010, Red River Basin Study Area 1/

Year	Farms	Farm labor 2/							
		Family incl. operator			All hired workers				
		Total farms reporting	Persons per farm	Total family labor	Total farms reporting	Persons per farm	Total hired workers	Total farm labor
	number	percent	- - number - -		percent	- - number - -		
1939	177,264	86.3	1.5	235,503	11.3	2.2	43,974	279,477
1944	152,385	87.2	1.5	197,314	2.4	1.9	6,939	204,251
1949	136,093	80.4	1.5	163,452	7.9	2.2	24,169	187,621
1954	112,857	85.8	1.6	155,395	12.4	5.8	81,975	235,370
1959	78,293	79.1	1.4	84,484	10.1	3.7	29.524	114,008
1962	77,150	79.7	1.5	92,232	10.8	5.0	41,660	133,892
1980	53,770	74.0	1.4	55,706	13.5	7.4	53,717	109,423
2010	32,800	64.5	1.4	29,618	18.1	11.6	68,869	98,487

1/ Whole counties are represented in the four basin states of Arkansas, Louisiana, Oklahoma, and Texas

2/ Farm labor was defined to include any work, chores, or planning necessary to the agricultural operations of the farm; and to exclude housework, contract construction work, custom machine work, and repair installation, or construction work done by persons employed specifically for such work. An operator was considered as working if he worked one or more hours; unpaid members of the operator's family, if they worked 15 or more hours; and hired persons, if they worked at all during the week.

Hired workers include "regular workers" (employed more than 150 days) and "seasonal workers" (employed less than 150 days).

Source: Census of Agriculture

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Trends in total farm labor, family farm labor, and all hired farm labor are shown in Table 16. With the total farm number rapidly decreasing, and the average size of farms increasing, the family farm labor force has continued to decline since 1939. Expanded farm size and industrialization are becoming more prevalent where rural farm population and low labor productivity were once common. The presence of employment opportunities is conducive to off-farm work. Therefore, it appears that industrialization provides an outlet for concentrated areas of subsistence units, under-sized farms, and under employment of labor on farms. Continued improvement in technology and mechanization will continue to be contributive factors in the decline of family farm labor. At the same time employment in agribusiness firms, such as farm supply, will respond to the increased need for off-farm services. However, farm employment data in this report does not include employment in the agribusiness firms.

The number of hired farm workers will remain fairly constant in the shortrun; however, there will be an increase in hired workers per farm. Measures directed towards production adjustment and improved resource use in the agricultural industry will be major factors in an increasing hired farm labor force.

The total family labor force is projected to continue decreasing through the year 2010 (table 16). This part of the total farm labor has historically decreased at a faster rate than farm numbers. This trend is projected to continue; however, family workers per farm are expected to decrease only slightly from 1.5 in 1962 to 1.4 in 2010.

The number of hired farm workers is influenced partly by the economic atmosphere in which the farmer operates. Inputs including hired labor are varied in response to expected returns. The number of hired workers in the basin is expected to increase in future time periods. However, the increase will not be as great as the decrease in family labor. The number of farm workers per farm is expected to increase from 7 in 1980 to about 12 by 2010.

The Census of Population has historically used a more restrictive definition of agricultural employment than the Census of Agriculture. This accounts for the apparent discrepancy between Tables 15 and 16, since the former is based on Census of Population data and the latter is based on Census of Agriculture data.

Forest Industry Employment

Employment in 1962 in the states of Arkansas, Louisiana, Oklahoma, and Texas had approximately 115,000 workers in primary and secondary forest industry. Outside of Houston and New Orleans, forest connected payrolls included about one-third of the four states' workers. In addition, a substantial share of the employment in construction, transportation, and marketing was directly attributable to wood products originating in the four-state area.

Table 17 shows employment in forest industry on the base area and an estimate of workers attributable to roundwood from the Study Area. Generally, employment in transportation and wholesale and retail marketing attributable to wood products is not included. This table includes only the transportation required to move raw wood products to the point of initial manufacture and the limited marketing facilities integrated with primary or secondary manufacturing plants.

Table 17 - Employment in Forest Industry, Red River Basin Study Area, 1962

	Basin Study Area 1/	Base Area 2/
	numbers	
Management and harvesting 3/	3,436	4,913
Primary manufacturing 4/	8,056	12,278
Secondary manufacturing 5/	2,436	3,231
State forest agencies	188	245
Other 6/	27	36
	14,143	20,703

1/ Estimates of employment attributable to roundwood produced on the Study Area

2/ Whole counties and parishes touched by the Study Area, except Panola County, Texas

3/ Includes personnel for management of Federal Forest lands

4/ The initial process when harvested roundwood is changed in form and/or utility

5/ Manufacturing process, or processes, after primary manufacture, that finish the product for marketing and/or consumption. Not required for use of all forest products.

6/ Includes other personnel employed in promoting the use, sale and production of forest products. Does not include personnel in academic and research fields.

Interim Trends and Projected Employment

The 1965 level of employment in forest industry on the Study Area and base area totaled 13,739 and 20,356, respectively. This data is comparable with that for 1962 in Table 17. The 1965 figures show employment at about 97 percent of 1962 levels. Information from the employment security divisions of Arkansas, Louisiana, and Oklahoma show more full-time jobs on the base area in 1965, than in 1962. The actual decrease in total employment between 1962 and 1965 took place mostly in the part-time and family-type logging and sawmill operations. Employment information on this segment of forest industry has been largely unreported.

Since 1965, ten major plants have been added to forest industry on the base area. These are under construction or operating (1967). On

the basis of forest land acquisition programs, selection of mill sites, affirmative engineering studies, and applications for manufacturing water needs, at least two additional major plants will be established before 1980. Estimates of initial labor requirements for these plants are as follows:

New Forest Industry, Base Area

Type	Operating or Building (1966-68)	Planned (1968-80)	Employment Needs 1/ Mill and Yard	Forest Management and Harvesting
Pulp and Paper	2	2	1,665	3,200
Pine Plywood	8	1	1,145	1,725
Total			2,810	4,925

1/ Based on information from company officials and/or needs of mills of minimum size for efficient operation

There are several factors that will influence future levels of employment in forest industry on the base area. Manufacturing facilities are being provided by new investments to utilize the full productivity of the Base Study Area, at the current level of management. A considerable number of new job opportunities are being provided during this period (1966-1980). The pressure for increased efficiency and higher employee productivity in established industry is causing a low rate of job loss, or increasing production with the same employee force. Improved mechanization and increasing automation will cause a general, steady attrition of jobs for a period of 20 to 30 years, in most sectors of forest industry.

Estimates of future employment attributable directly to roundwood produced on the Basin Study Area follows, with total employment in forest industry on the base area are as follows:

Year	Total Employees Basin Study Area	Base Area
1980	17,000	24,400
2010	12,900	19,800

This employment data does not include the share of employees attributable to Study Area timber in transport of the finished products of secondary manufacture, in the marketing field, in construction, or in the many industries where wood makes-up a minor share of the raw materials used.

TRANSPORTATION

The Study Area is served by the Texas & Pacific, Kansas City Southern, Frisco, Missouri Pacific, and St. Louis & Southwestern Railroads. Two interstate highways transverse the basin; Interstate 30

in the northeastern-southwestern direction; and Interstate 20 in an east-west direction intersecting at Dallas, Texas. U. S. Highway 71 parallels the Red River from Alexandria, Louisiana, to Texarkana, Arkansas. Several state highways and numerous well-maintained county roads link the population centers.

Transcontinental bus service is available on all major highways. The motor truck industry handles a considerable amount of intercity traffic.

Shreveport and Alexandria have the only airports that are used by a transcontinental carrier (Delta Airlines) for major flights. Alexandria and Texarkana are served by Trans-Texas Airlines, which provided feeder service to larger terminals in the Mid-South. There are other smaller airports in the Study Area which provide public and private air facilities. It was assumed that in the future the Study Area will continue to have adequate transportation facilities; therefore, no projections regarding transportation were made.

NON-AGRICULTURAL USES OF LAND

Preemptive nonagricultural use of land is expected to increase in the future. Urban areas are expected to expand to provide homesites, service, and industrial development areas. In rural areas, highways and communities are expected to use more land.

Given the expected increases in population, the amount of land needed to accomodate the larger number of people will depend on the population density. Population density has a direct relationship to homesite, service, and industrial development land use.

Decreases in population occurred in 12 instances, or 25 percent of the incorporated places having 2,500 inhabitants. Losses in population of individual incorporated places varied from nine to more than 1,600. In Arkansas and Oklahoma there are 14 incorporated places of 2,500 or more in the Study Area. Half of them decreased in population between 1950 and 1960. Increases in population occurred in 35 of the urban places in the Study Area. Increases ranged from as few as 31 persons in Nashville, Arkansas, to more than 37,000 in Shreveport, Louisiana.

The average relationship between urban population and urban land area for the entire Study Area was approximately .125 acres per person. This estimate includes only land inside the corporate limits of urban places. Highways or recreational land outside the corporate limits were not considered. Between 1960 and 1980, highways are estimated to require 23 acres per 1,000 increase in population. By 1980, the interstate system is assumed complete, and the highway requirement from 1980 to 2010 is estimated at 20 acres per 1,000 increase in population. Highway land use estimates were based on research conducted by ERS.

The total nonagricultural land use requirement for urban and built-up, including highway construction to account for the urban population increases expected between 1960 and 1980, is about 148 acres per 1,000.

Between 1980 and 2010, the figure is expected to drop to 145 acres. About 76,000 acres more land would be required for urban and built-up uses in 1980 than in 1962, and almost 172,000 acres additional by 2010. Thus, the amount of urban and built-up land in 2010 would be 247,900 acres more than in 1962. The latter represents 4.3 percent of the 1962 total land area versus 3.0 percent in 1962.

Some of the urban development projected will have impact on rural lands such as cropland, forests and woodlands, and areas not in farms. The proposed project developments by communities in the Study Area will influence urban and built-up expansion. An assessment of the economic impacts will be considered in a latter section of the Appendix.

AGRICULTURAL DEVELOPMENT

Farm Numbers and Size

About 78,300 farms were reported in the Study Area in 1959 by the Census of Agriculture (table 18). These data indicate that approximately 40 percent were commercial farms; 42 percent were part-time farms; and 18 percent were part-retirement farms. 1/ There were 8,355 farms in Arkansas, 28,964 in Louisiana, 15,077 in Oklahoma, and 25,987 in Texas. By 1962, it was estimated that the total number of farms had decreased to 77,150.

Table 18 - Trends in Farm Numbers, Size, and Land in Farms, 1934 Through 1959 and 1962 Projected to 1980 and 2010, Red River Basin Study Area 1/

Year	Farms	Average Size	Land in Farms	Proportion of Total Land Area in Farms
	number	acres	thousand acres	percent
1934	219,086	73.8	16,180	NA
1939	177,264	88.7	15,719	53.2
1944	152,385	98.8	15,063	51.1
1949	136,093	118.1	16,070	54.6
1954	112,857	138.7	15,657	53.2
1959	78,293	187.5	14,683	50.1
1962	77,150	190.0	14,660	51.4
1980	53,770	270	14,520	49.9
2010	32,800	416	13,640	47.4

1/ Whole counties are represented in the four basin states of Arkansas, Louisiana, Oklahoma, and Texas. Compiled from U. S. Census of Agriculture Bureau of Census, Department of Commerce.

1/ Commercial farms include all farms with a value of sales amounting to $2,500 or more. Part-time farms include farms with a value of sales of farm products of $50 to $2,499 and operators under 65 years of age that either worked off the farm 100 days or more or had other income from non-farm sources that was greater than the total value of farm products sold. Farms with a value of sales of farm products of $50 to $2,499 were classified as part-retirement if the farm operator was 65 years old or over.

Farms are rapidly increasing in size. While the number of farms has decreased by 65 percent since 1934, the average size has more than doubled. Land in farms also decreased. However, the proportion of land area in farms has only decreased 3 percent since 1939.

There are a number of reasons for the increase in farm and ranch size. Cost-price problems of recent years have encouraged a constant search for economies in operation. The extensive grain and livestock operations are particularly conducive to economies of scale. Technological advancement, a major factor in a number of agricultural changes, has influenced expansion in ranch and farm size in at least two ways. First, the use of more efficient equipment and methods make possible additional output with the same number of manhours; and second, the cost of new innovations, a fixed expense, must often be spread over land to be economically justified.

There will be a continued decrease in the number of farms. Those remaining will be larger and better managed as a result of improved farming techniques, market news distribution, and more highly trained farm management. Also, mechanization of farm operations will allow a higher percentage of planted acreages to be harvested with minimum loss.

Trends in farm numbers, size, land in farms, and the proportion of total land area in farms for 1980 and 2010 are presented in Table 18. The projected rate of change for the number of farms is more between 1962 and 2010 than the historical rate of change between 1949 and 1959 (table 20). However, the average size farm unit is projected to increase about 120 percent by 2010 over the 1962. The larger size units will be offset by the increased number of farms being divided into smaller units in the area surrounding Shreveport, Bossier City, Alexandria, and Texarkana. These smaller units may still be classified as rural nonfarms by Census criteria, but will become suburban homes with acreages. This is substantiated by the increase in "rural non-farm" population projections presented in Table 14. This will, of course, affect the distribution of the size of farms throughout the Study Area. The farms in the outer regions will continue to increase in size and decrease in numbers.

The proportion of total land area in farms has historically decreased since 1939 (table 18). The same trend has been extended to 2010. Total land area in farms is projected to decrease approximately 8 percent by 2010 from the 1962 farm land area.

Tenure

Census data indicate that in 1959, 62 percent of the farmers were full owners; 19 percent were tenants; 18 percent were part-owners; and one percent were professional managers. No projections were made of tenure situations.

Type of Farm

Farms are classified by type on the basis of their major source of income. This classification indicates the major characteristics of the agriculture in the Study Area. These characteristics are influenced by such physical factors as soil, rainfall, temperature, and topography.

Economic factors influencing type of farming include population, population distribution, transportation, production cost, and commodity prices. Fundamentally, agriculture in the basin is oriented to production of commodities which can be readily shipped to population centers (table 19). Production of perishable commodities, vegetables and milk, are limited to supplying the local demand.

Table 19 - Farms by Type: Percentage Distribution of Farm Numbers, 1949, 1954 and 1959, Red River Basin Study Area

Farms by type	1949	1954	1959
		percent	
Cash - grain	1.0	1.1	1.5
Cotton	30.3	24.2	14.1
Other field - crop 1/	3.4	1.8	1.9
Vegetable	0.4	0.3	0.3
Fruit - and - nut	0.3	0.2	0.2
Poultry	0.9	1.5	2.0
Dairy	2.4	2.6	3.1
Livestock 2/	9.2	10.6	16.8
General	5.5	3.5	2.6
Miscellaneous	46.6	54.2	57.5
Total	100.0	100.0	100.0

1/ Other than vegetable, fruit-and-nut farms
2/ Other than poultry and dairy
Source: Census of Agriculture

The second most common type of farm was livestock (other than dairy and poultry). Livestock farms have practically doubled in number during the past decade. Cotton farms have decreased from 30 percent of all farms in 1949, to 14 percent in 1959.

In 1959, livestock, dairy, and poultry farms accounted for 22 percent of all farms, while field crop farms accounted for 18 percent. By contrast, in 1949, these same farm type classification groupings were 12 percent and 35 percent, respectively.

Nearly 58 percent of the farms were classified as miscellaneous farms, or farms which have no single segment of income representing more than 50 percent of the total value of all farm products sold

during the year (table 19). This type of farm classification includes sources of cash income from nursery and greenhouse products, forest products, mules, horses, colts, and ponies.

Value of Agricultural Production

Agricultural income in the Study Area was about $29[illegible] million in 1962 (table 20). Crops accounted for 42 percent of the agricultural income, and livestock accounted for 57 percent. Forest products sold by farmers accounted for the other one percent. This does not include value of products sold from commercial forest land.

Table 20 - Estimated Value of Farm Products Sold, 1962 and Projected to 1980 and 2010, Red River Basin Study Area

Commodity Sold	1962		1980 1/	2010 1/
	thousand - dollar -	percent	thousand - - - dollar - - -	
Dairy products	29,985.5	10.1	49,176	71,665
Poultry products	31,500.0	10.6	48,195	60,480
Livestock & livestock products	107,826.3	36.2	183,305	271,722
Total livestock products	169,311.8	56.9	280,676	403,867
Field crops 2/	117,864.5	39.6	200,370	298,197
Vegetables	1,871.8	0.6	2,770	3,968
Fruits and nuts	2,709.3	0.9	4,037	5,852
Horticultural specialities	2,628.1	0.9	3,916	5,677
Total crops	125,073.7	42.0	211,093	313,694
Forest products	3,284.0	1.1	7,192	12,347
Total agricultural income	297,669.5	100.0	498,961	729,908

1/ Based on 1962 dollars
2/ Other than vegetables, fruits and nuts

Field crops represented 40 percent of the agricultural income in the Study Area. Cotton was the most important crop with receipts of about $36.4 million. Hay crops and corn were the second and third most important cash crops, accounting for another $22.7 million. These crops account for approximately 20 percent of the total agricultural income. Vegetables, fruits and nuts, and horticultural specialty crops together account for only 2.4 percent of the income.

Trends in the value of crops, livestock, and forest products in actual dollars are shown in Figure 7. Since 1939, the value of livestock and livestock products sold has increased approximately sevenfold. The value of crops only doubled between 1939 and 1962. The increase in value of livestock and livestock products is primarily a result of higher production and prices for cattle which has more than offset the decline in hog production. Cattle and calves are rapidly becoming a major

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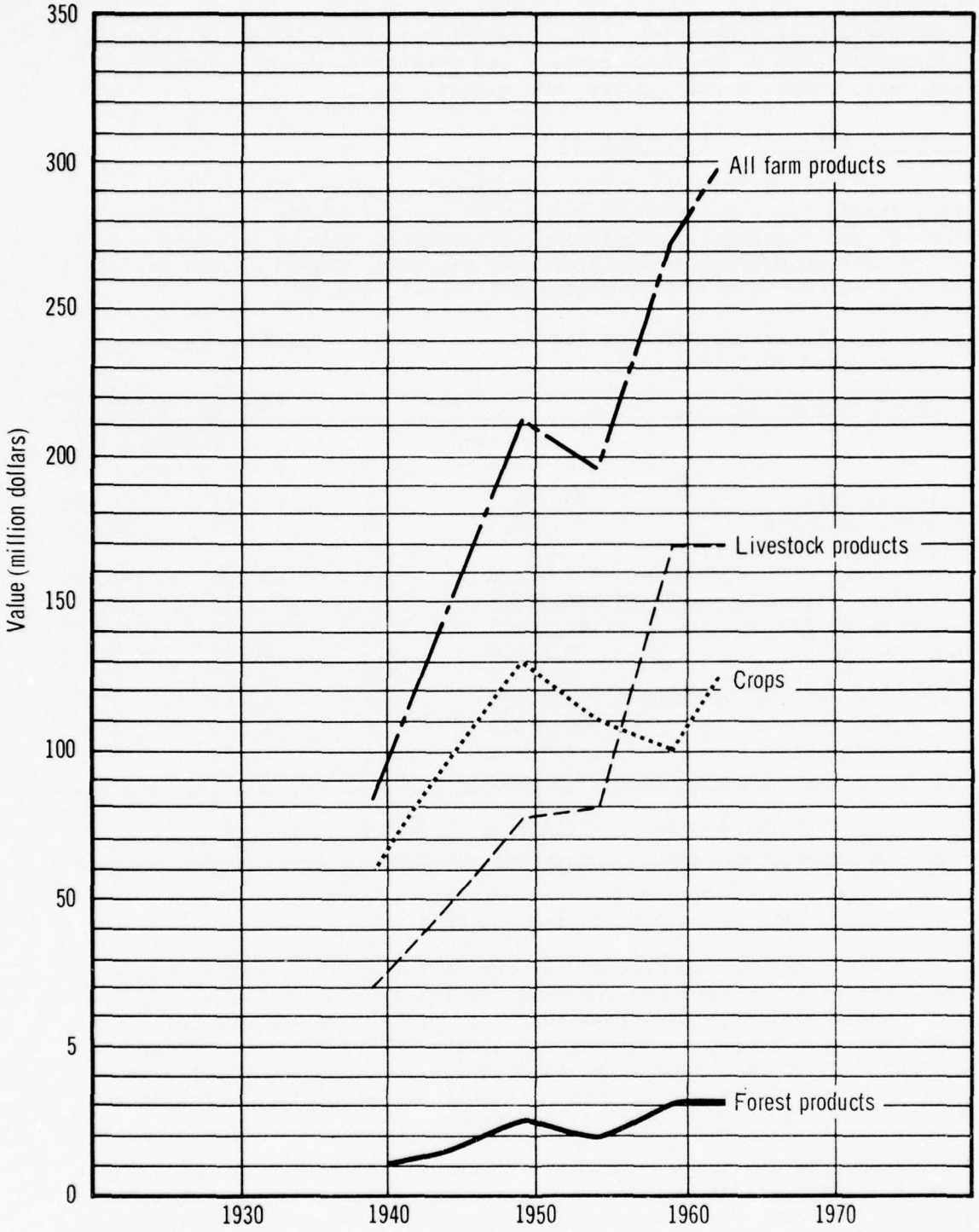

SOURCE: U. S. Census of Agriculture and Statistical Reporting Service

Figure 7

VALUE OF FARM PRODUCTS SOLD
RED RIVER BASIN STUDY AREA, 1939-1962

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segment of the agricultural industry. The increase in value of crops is due to high production of cotton, hay, and corn and favorable prices received, which have offset the decline in acreage of some crops, notably cotton and corn.

Projected values of farm products sold are based on a 1962 price level. The total value of farm products sold is projected to be approximately $499 million in 1980, and $730 million in 2010 (table 20). All of the major components of income to agriculture, livestock, crops, and forest products, are projected to increase.

The cash value of on-farm domestic consumption of farm products is negligible and was not considered. It was assumed that the value of on-farm consumption is directly related to rural-farm population. This form of consumption is expected to decline in relative importance because rural-farm population is expected to decline while total farm production is expected to increase.

Land Use

Eighteen percent of the total land area is used as cropland. Approximately 17 percent is grassland pasture and range. Over one-half is in forest-woodland. If grassland is included, about 35 percent of all land is in crop and livestock production (excluding grazing on forest lands). If the forest-woodland is included, the area in agricultural use is about 90 percent. In Table 21, total land use is presented for the inventoried area only.

Table 21 - Land Utilization: Trends in Major Agricultural Land Uses, 1939-1959, Red River Basin Study Area

Major agricultural uses:	1939	1944	1949	1954	1959
			thousand acres		
Total cropland	9,323.3	6,572.3	6,688.9	5,572.3	4,880.9
Crops and related uses 1/	6,910.1	5,357.0	4,721.4	3,496.6	2,869.8
Cropland used only for pasture	2,413.2	1,215.3	1,967.5	2,075.7	2,011.1
Pasture 2/	NA	3,805.1	3,413.9	4,448.7	4,613.3
Woodland	3,986.7	3,976.6	5,345.8	5,149.5	4,706.1
Other land 3/	NA	547.4	622.6	459.2	480.6
Total land in farms	-	14,901.4	16,071.2	15,629.7	14,680.9

Census of Agriculture
Acreages rounded to nearest hundred
1/ Cropland harvested, crop failure, fallow, and idle cropland
2/ Grassland pasture and other non-forest rangeland, excluding cropland used only for pasture
3/ Farmsteads, farm roads, idle land, wildlife areas, etc.

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Cropland acreage was high in 1939 with 9,323,300 acres (table 21). There has been a decline in cropland since the 1939 census of 4.4 million acres.

Grasslands pasture and other nonforest rangeland, excluding cropland used for pasture, were 808 thousand acres more in 1959 than in 1944. Much of this land use change was from lower quality cropland. Interchange between cropland and pasture has occurred in the better quality land areas of the Study Area. When demand is low, cropland tends to decrease, with part of the excess going into grassland pasture. Total acreages used for pasture purposes have increased from 5,020,400 in 1944 to over 6,624,000 acres in 1959. 1/

Substantial shifts have been made between land uses in some sectors of the Study Area. Cropland is being concentrated on fertile and more nearly level areas. Hilly and eroded land is being put in grass and trees. This shift of field crops to the more productive land has increased average yields.

A shift in the use of the land resource base is taking place along with the reduction of the resource base itself. The withdrawal from cultivation of lands of poor quality is affecting the land use pattern.

CNI data were used to determine major land use categories by soil groups by resource areas for each of the four states and the Study Area. These data were for 1958. Inventory acreages, or total land in farms, and non-inventory acreages were adjusted to 1962 conditions to reflect changes in large water areas by counties and LRA.

Cropping patterns for each LRA grouping were determined from 1962 crop reports. The cropping pattern for sample county data was tabulated for each LRA grouping, and the distribution of each crop was aligned to the 1962 adjusted CNI "total cropland acreage".

Similarly, cropland harvested, pastured, and idle, or fallow, historic trends were used to determine the percentage change for each use. The percentage distribution for each use was applied to the 1962 adjusted CNI "total cropland acreage".

The projected increases in fresh water and nonagricultural areas indicate a reduction of approximately 281,600 acres in the area devoted to agriculture between 1962 and 2010. This loss of agricultural lands to other uses plus the projected increase in demand for agricultural and forestry products will cause substantial changes in land use within the agricultural area. The increased demand will be supplied in part by improved technology and more efficient operations. In addition, a greater portion of the agricultural area will be utilized for production of the more intensive crops and improved pasture. This will cause a shift to the more productive, less hazardous soils, at the expense of rangeland and woodland.

1/ "Cropland" used only for pasture and "pasture"

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Projected 1980 acreages of the major agricultural uses are: feed grains including wheat 299,600; cotton 232,200; hay crops and silage 658,800; improved pasture 1,209,200; other crops 465,000; pasture and rangelands 3,268,100; forest and woodland 10,703,900; and other uses 413,000. Corresponding acreages for 2010 are: feed grains including wheat 309,500; cotton 112,200; hay crops and silage 670,200; improved pasture 1,190,900; other crops 451,700; pasture and rangeland 3,411,500; forest and woodland 10,245,800; and other uses 659,900.

The projected 1980 and 2010 land utilization as it pertains to land in farms and major crop distribution without project development is summarized in Table 22.

Table 22 - Projected Land Utilization: Land in Farms, Major Agricultural Use with Crop Distribution, Without Project Development, Red River Basin Study Area, 1980 and 2010.

Land Use	1980	2010
	- - - - thousand acres - - - -	
Total cropland:	2,864.8	2,734.5
Cotton	232.2	112.2
Corn silage	12.1	5.6
Corn grain	45.9	26.2
Oats	58.1	63.0
Barley	19.5	21.0
Sorghum, silage	19.3	10.2
Sorghum, grain	73.7	85.4
Wheat	102.4	113.9
Rice	5.5	5.0
Soybeans, forage	46.4	16.0
Soybeans, beans	51.7	86.0
Peanuts	28.0	19.5
Sweet potatoes	20.0	16.9
Vegetables	21.6	21.4
Cowpeas	2.8	-
Sugarcane/sugar	1.0	1.0
Field seed crops (other)	35.0	35.8
Alfalfa	45.6	50.2
Other hay	535.4	588.2
Fruit, noncitrus	14.8	15.0
Other	5.1	5.3
Nonharvested: idle, fallow, etc.	279.5	245.8
Pastured	1,209.2	1,190.9
Pasture-Range	3,268.1	3,411.5
Forest-Woodland:	10,703.9	10,245.8
Grazed	6,974.4	6,677.4
Not grazed	3,729.5	3,568.4
Other land:	413.0	659.9
Total land in farms	17,249.8	17,051.7

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A more detailed delineation of land use data is presented in Exhibits 5, 6, and 7. These exhibits display projected land use data by the five land resource area groupings, land in farms, and major crop distribution.

Cropping Pattern

Cropland in the Study Area is utilized for the production of a number of crops (table 23). Over 59 percent of the cropland was in pasture and forage crops during the base year of 1962. Cotton, feed grains, wheat, and soybeans harvested for beans utilized approximately 23 percent of the cropland. Minor crops, fallow, and idle acreage accounted for the remainder of the total cropland acreage, or 18 percent. The 3,389,100 acres of cropland, together with the 3,160,900 acres of pasture and 6,717,500 acres of woodland grazed, represented 76 percent of the total land in farms utilized for the production of crops and cattle industry.

Over 54 percent of the total land in farms in LRA 86 is utilized as cropland. Cotton is the major single crop harvested, but pasture and forage crops represent 18 percent of the acreage. Small grains, grain sorghum, and corn, occupy a large total acreage.

Approximately 52 percent of LRA 131, 134 grouping is in cropland, and pasture and range; the remainder of the total land in farms is in forest-woodlands and other land uses. This is an important cash crop area. Cotton, soybeans, and corn grown by highly mechanized methods are major cash crops in this grouping. However, pastured cropland and hay crops account for over 16 percent of the total farm land use.

Over 20 percent of the land in farms is cropland throughout the LRA 85, 112, grouping. Hay, small grains, grain sorghums, peanuts, cotton, and corn are the principal crops. About half of the total land in farms is in pasture-range which supports beef cattle and other livestock grazing.

Less than one-fifth of the land in farms in the LRA 80, 84, 133 grouping is in cropland. The proportion of forest-woodland acreages is greatest in this grouping. Corn, cotton, vegetables, and grain sorghum were important crops in 1962. Hay crops and pastured cropland utilize the major portion of all cropland. The trend is to more pasture and woodland and less cropland.

Approximately 90 percent of the agricultural land use of LRA 119 is forest-woodland. Pastures and mixtures of tame hay are the main crops.

Following determination of the projected acreage of cropland and pasture-range available for agricultural use by 1980 and 2010, the production of major crops that could be obtained without an acceleration in the rate of resource development was then computed (table 24). Projected harvested acreages for crops are displayed

Table 23 - *Land Utilization:* Land in Farms, Major Agricultural Use With Crop Distribution, By Major Land Resource Area Groupings, 1962, Red River Basin Study Area

Land Use	LRA 86	LRA 131, 134	LRA 85, 112	LRA 80, 84, 133	LRA 119	Basin Total
			thousand acres			
Total cropland:	965.8	737.8	236.3	1,392.7	56.5	3,389.1
Cotton	235.8	114.4	8.6	34.4	Z	393.2
Corn, silage	1.4	6.8	0.2	4.3	0.1	12.8
Corn, grain	51.7	40.6	5.9	52.7	1.0	151.9
Oats	35.9	4.6	3.3	2.2	-	46.0
Barley	13.5	Z	0.7	0.3	-	14.5
Sorghum, silage	10.1	0.5	3.4	13.1	0.2	27.3
Sorghum, grain	27.9	0.5	10.6	9.4	0.2	48.6
Wheat	78.4	1.7	2.0	0.4	-	82.5
Rice	-	7.9	-	-	-	7.9
Soybeans, forage	2.9	35.9	0.3	0.9	-	40.0
Soybeans, beans	2.4	26.9	1.7	0.3	-	31.3
Peanuts	11.3	-	16.0	6.8	-	34.1
Sweet potatoes	Z	14.7	Z	8.4	-	23.1
Vegetables	0.9	2.0	0.4	15.5	-	18.8
Cowpeas	2.2	0.8	0.7	6.2	-	9.9
Sugar/sugar	-	1.0	-	-	-	1.0
Field seed crops (other)	31.0	1.5	0.7	1.4	-	34.6
Alfalfa	17.8	9.8	8.9	4.2	-	40.7
Other hay	100.8	76.9	35.2	156.0	11.3	380.2
Fruit, non-citrus	1.9	6.8	0.8	5.3	0.2	15.0
Other	0.1	Z	0.1	0.6	Z	0.8
Not harvested: idle, fallow, etc.	151.2	51.3	31.9	225.1	2.6	462.1
Pastured	188.6	333.2	104.9	845.2	40.9	1,512.8
Pasture-Range:	491.4	569.7	530.5	1,421.9	147.4	3,160.9
Forest-Woodland:	301.4	1,154.3	277.3	6,116.5	2,436.9	10,286.4
Grazed	244.1	600.2	252.3	4,036.9	1,584.0	6,717.5
Not grazed	57.3	554.1	25.0	2,079.6	852.9	3,568.9
Other land:	27.2	50.2	101.2	235.0	83.3	496.9
Total land in farms	1,785.8	2,512.0	1.145.3	9,166.1	2,724.1	17,333.3

Source: USDA National Inventory of Soil and Water Conservation Needs 1958, adjusted to 1962 conditions

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in Exhibits 5, 6, and 7 by each land resource area grouping. The projected crop yields together with the harvested acreages were used to determine the potential agricultural production for the economic evaluation period 1962 to 2010.

Table 24 - Selected Crops: Production by Land Resource Areas Without Project Development, Projected 1980 and 2010, Red River Basin Study Area

Crops	Units	Study Area		LRA 86		LRA 131, 134	
		1980	2010	1980	2010	1980	2010
		- - - - - thousands - - - - -					
Cotton	lbs.	140,550	97,392	87,025	64,242	45,472	30,804
Feed grains:							
Corn	bu.	2,243	1,639	1,004	368	870	1,088
Oats	bu.	1,722	2,223	1,305	1,635	218	328
Barley	bu.	468	567	468	567	-	-
Sorghum	bu.	2,848	4,100	1,790	2,989	51	160
Wheat	bu.	2,575	3,127	2,405	2,876	84	152
Rice	lbs.	25,520	30,600	-	-	25,520	30,600
Soybeans	bu.	1,403	3,548	105	129	1,212	3,284
Peanuts	lbs.	23,970	22,747	8,910	5,605	-	-
Sweet potatoes	bu.	2,382	2,210	-	-	1,338	1,430
Vegetables	cwt.	1,897	2,111	41	43	192	229
Alfalfa & mixture	ton	117	163	45	59	28	53
Other hay	ton	867	1,264	142	177	231	342
Sugarcane for sugar	ton	27	33	-	-	27	33
Fruit, noncitrus	ton	15	17	2	2	5	6
Pasture & range	AUM	18,830	19,635	3,724	4,184	4,292	4,774
Cropland pastured	AUM	7,440	8,910	1,744	2,405	1,629	1,727
Woodland pastured	AUM	2,037	1,948	127	121	183	124

Table 24 - Continued

Crops	Units	LRA 85, 112		LRA 80, 84, 113		LRA 119	
		1980	2010	1980	2010	1980	2010
		- - - - - thousands - - - - -					
Cotton	lbs.	2,485	2,346	5,568	-	-	-
Feed grains:							
Corn	bu.	104	43	265	140	-	-
Oats	bu.	140	209	59	51	-	-
Barley	bu.	-	-	-	-	-	-
Sorghum	bu.	455	554	548	392	4	5
Wheat	bu.	78	99	8	-	-	-
Rice	lbs.	-	-	-	-	-	-
Soybeans	bu.	69	105	17	30	-	-
Peanuts	lbs.	11,656	13,992	3,404	3,150	-	-
Sweet potatoes	bu.	-	-	1,044	780	-	-
Vegetables	cwt.	29	34	1,575	1,805	-	-
Alfalfa & mixture	ton	29	32	15	19	-	-
Other hay	ton	69	101	402	613	23	31
Sugarcane for sugar	ton	-	-	-	-	-	-
Fruit, noncitrus	ton	1	1	7	8	-	-
Pasture & range	AUM	4,786	3,424	5,522	6,618	506	635
Cropland pastured	AUM	394	434	3,565	4,230	108	114
Woodland pastured	AUM	109	105	1,293	1,231	325	317

The total projected agricultural production in the Study Area for each crop is the sum total of production by LRA grouping and time frame.

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Feed units produced without an acceleration in the rate of resource development amounted to 11,722 million in 1962. In 1980 and 2010, the projected feed unit production using this same assumption, amounts to 13,824 million and 15,163 million, respectively.

Yields

The cropping pattern and yield of each crop, including the yields of pasture and range and woodland pastured, were determined for the major land resource area groupings and the Study Area (exhibit 8). Estimated yields were obtained from State Offices of SCS for all major crops by soil groupings in the land resource areas. These estimates were used as guides in determining yields under current conditions. Also, a current yield was calculated from 1934-62 record of acreage and production of each crop in the sample counties for each LRA grouping. These two sources were adjusted to agree to determine yields for each major crop.

Current yields reflect a high level of management using present technology. It was assumed that the yields presented in Exhibit 8 represent the average yields in 1962. Using this data on cropping patterns and yields by LRA groupings, the production of crops in the base year was estimated.

Crop yield projections for individual crops for 1980 and 2010 were based on historical trends and future expected improvement in production technology. Production technology was considered to encompass all factors that result in increased agricultural production other than resource development and major land use change.

Yield data for major crops by land resource area groupings are presented in Exhibit 8. Weighted yield data were computed for the entire Study Area based upon crop acreage harvested and yields within the LRA groupings.

Livestock

The land and water resources of the Study Area supported in 1962 a livestock population of about 2,110,000 cattle and calves, 305,000 hogs and pigs, 58,000 sheep and lambs, and 58,000 horses and mules (table 25). In addition, 3,460,000 chickens (4-months or older) and 228,000 turkeys are raised annually.

Poultry production is an important agricultural industry. It is estimated that over 70,000,000 broilers were raised during 1962.

Table 25 - Livestock Numbers, 1962, Projected 1980 and 2010, Red River Basin Study Area 1/

Livestock	Livestock Numbers		
	1962	1980	2010
	- - - - thousands - - - -		
Cattle & calves	2,110	2,808	3,970
Horses & mules	58	38	23
Hogs & pigs	305	252	230
Sheep & lambs	58	68	85
Broilers 2/	70,159	107,450	225,645
Chicken, 4 mos. & older	3,460	7,907	9,884
Turkeys	228	248	281

1/ Whole counties are represented in the four Basin States of Arkansas, Louisiana, Oklahoma, and Texas

2/ Assumed 12 weeks for total broiler production

Additionally, 3.5 million other chickens (over 4-months of age) and 228,000 turkeys were raised.

The 173,000 milk cows are raised predominately in the Texas and Louisiana portion of the area. Over 75 percent of the milk cows are in these two states where the largest population centers are located. Also, forage and pasture is available in the prairies and bottomland land resource areas.

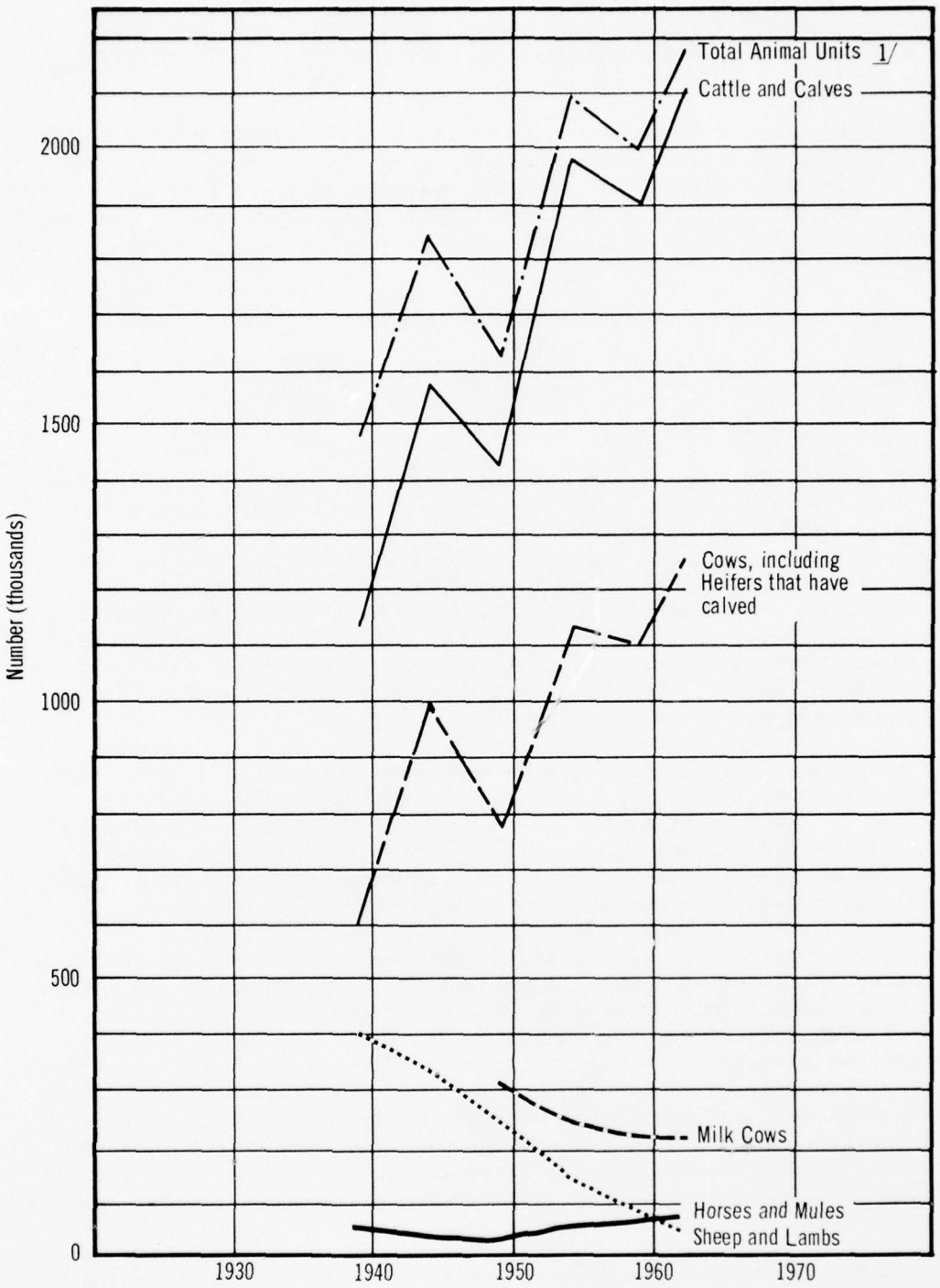
Milk cow numbers have declined since 1949 from a reported 314,200 head. This decline is consistent with the national trend and is associated with the decline in consumption of dairy products per capita and the rapid rise in milk production per cow.

Although beef cattle are raised throughout the Study Area, they are most numerous in the Texas counties where extensive grazing land is available. Livestock farm numbers increased in Texas, Oklahoma, and Louisiana since 1954, giving an indication of the increased importance of livestock feeding operations in the Study Area.

Sheep are more prevalent in the Texas and Oklahoma portion of the Study Area where rangeland is available for grazing. Sheep numbered about 58,000 head, approximately the same as 23 years earlier. The lowest level was reached in 1949.

There are 58,000 horses and mules in the Study Area. With the advent of mechanized power on the farm, horses and mules were no longer needed and have continually decreased in numbers since 1939.

The net results of the changes in animal numbers is shown in Figure 8 in terms of animal units. Cattle and calves numbers have



1/ Factors used to convert livestock into animal units are: 1 cow = 1 AU, 1 sheep = 2 AU, 1 horse = 8 AU

SOURCE: U. S. Census of Agriculture and Statistical Reporting Service

Figure 8

LIVESTOCK NUMBERS FOR WHOLE COUNTIES IN RED RIVER BASIN STUDY AREA, 1939-1962

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been increasing while horses and mules, sheep and lambs have been decreasing. Thus, total animal units have remained fairly constant since 1954.

Projections of livestock numbers in Table 25 indicate that cattle, calves, and poultry are expected to increase considerably over their 1962 levels in 1980 and 2010. Horses, mules, hogs, and pigs are expected to decrease rather rapidly in number during this time. These changes are a result of the continuance of factors leading to the present situation.

FOREST PRODUCTION AND RELATED ECONOMIC ACTIVITY

1962 Development and Production Levels

Pine Production and Sawmill Industry

Historically the largest segment of forest industry in Arkansas, Louisiana, Oklahoma, and Texas, has been involved in the production of pine lumber. This sector of forest industry participated in the strong lumber market generated by the home building boom in the late 1940's and early 1950's, but in the middle 50's, rising operating costs began to increasingly affect forest-based enterprise. Steadily rising labor costs placed a particular strain on poorly mechanized and relatively inefficient operations. Increased competition from Western and Canadian lumber (see exhibit 9) and from substitute materials compounded the difficult situation.

When the general building boom subsided in the late 1950's, (see exhibit 10) pine lumber producers were caught in a price-cost squeeze and many of the smaller mills and yards were forced out of business. Small producers of other products such as posts, crossties, and fuel wood were seriously affected by rising labor costs, and many of their operations closed down during this period (1958-62)

Many companies had to reorganize and reequip to meet the challenge of rising costs and increasing competition. Mill machinery and layouts were modernized. The handling of logs and lumber were more fully mechanized. Some of the more competitive firms expanded operations, integrating processes for new products and raising the grade and finish of other products by additional processing. Utilization was improved by new machinery and additional employee training. More mill residues were reclaimed for wood pulp and other products. Management was intensified on land dedicated to wood production. Table 26 lists mills and manufacturing plants of forest industry that were doing business at the close of 1962.

These efforts and expenditures were justified by the relatively large tracts of forest land with unbroken ownership, integrated in many cases with mill operation, and the rapid increase in growth and inventory on well-managed forest lands. Table 27 shows net annual growth for 1962 by states and species groups. Table 28 shows the 1962 percentage distribution of stands by size classes.

Table 26 - Primary and Secondary Manufacturers in Forest Industry, Red River Basin Study Area, 1962

	Number of mills	
	Study Area	Base Area 1/
Sawmills, large 2/	38	63
Sawmills, small	120	126
Wood preserving plants	17	24
Veneer mills	5	6
Wood pulp mills	2	6
Miscellaneous 3/	26	31
Total	208	256

Source: State directories of forest industries
1/ Includes facilities in Study Area
2/ Output of more than 3 million board feet/day
3/ Cooperage, handles, charcoal, etc.

Table 27 - Net Annual Growth of Growing Stock and Sawtimber by Species Groups by States, Red River Basin Study Area, 1962

State	Growing Stock			Sawtimber		
	All Species	Soft-wood	Hard-wood	All Species	Soft-wood	Hard-wood
	million cubic feet			million board feet		
Arkansas	74.7	49.7	25.0	287.4	236.4	51.0
Louisiana	152.1	126.5	25.6	669.0	582.1	86.9
Oklahoma	71.9	34.9	37.0	182.4	132.5	49.9
Texas	46.6	30.5	16.1	136.4	101.0	35.4
Entire Basin	345.3	241.6	103.7	1,275.2	1,052.0	223.2

Source: State Forest Survey Reports, Southern Forest Experiment Station, USFS

The production of pine sawtimber and total industrial roundwood was up in 1962 on the Basin Study Area, above the lows of 1954, 1958, and 1960-61. Table 29 shows the volume of industrial roundwood products for 1962.

Hardwood Production and Manufacture

Thirty percent of the 1962 production of industrial roundwood for the Basin Study Area was hardwood. A little more than half of this hardwood was sawlog material and about one-quarter was pulpwood.

Table 28 - Area and Distribution of Forest Land by Stand Size Classes and Species Groups, Red River Basin Study Area, 1962

Stand Size Class	Softwoods		Hardwoods		All Types	
	Thou. Acres	Percent of Area	Thou. Acres	Percent of Area	Thou. Acres	Percent of Area
Sawtimber 1/	2,324.7	45	1,775.6	35	4,100.3	40
Poletimber 2/	1,270.9	25	1,521.2	30	2,792.1	27
Seedlings & Saplings 3/	1,510.5	29	1,616.0	32	3,126.5	31
Non-stocked or Other 4/	29.5	1	132.0	3	161.7	2
All Stand Sizes	5,135.6	100	5,044.8	100	10,180.6	100

Source: State Forest Survey Reports, Southern Forest Experiment Station, USFS

1/ At least 10 percent stocked with growing stock trees, mostly sawtimber

2/ At least 10 percent stocked with growing stock trees, mostly poletimber

3/ At least 10 percent stocked with growing stock trees, mostly seedlings and/or saplings

4/ Commercial forest land less than 10 percent stocked with growing stock trees

Table 29 - Industrial Roundwood Production, 1962, Red River Basin Study Area

Product	Volume		
	Thousand Cubic Feet		
	Pine	Hardwood	Total
Sawtimber	58,934	25,090	84,024
Veneer	0	1,891	1,891
Pulpwood	48,844	13,406	62,250
Piling	678	0	678
Poles	4,302	-	4,302
Posts	3,208	605	3,813
Cooperage	-	47	47
Hewn ties	84	1,427	1,511
Fuelwood 1/	357	2,248	2,605
Miscellaneous Products 2/	304	3,614	3,918
Total Industrial Roundwood	116,711	48,328	165,039

Source: State Forest Survey Reports, special reports by Southern Forest Experiment Station, severance tax and other published reports

1/ Includes some material used for charcoal production

2/ Includes roundwood used in manufacture of handles, boxes and crates, some sawn ties, hickory chips, and other specialty items

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Table 29 shows the volume of these and other hardwood products for 1962.

Flooring and dimension stock are the principal items manufactured from factory grade hardwood logs. The smaller mills cutting hardwood logs habitually produce rough lumber and crossties. The lumber from these mills is usually graded, finished, and merchandized by concentration yards. These smaller operations were reduced in numbers by the rising operating costs in the late 1950's, and early 1960's.

In 1961, the production of hardwood sawlog and veneer logs on the Study Area reached the lowest point since 1950. This trend was in step with other producing areas of the entire Southeast (see exhibit 11). Demand started to rise in 1962.

Most of the higher quality hardwood sawlogs are produced on the floodplain of the lower Red River and that part of the Mississippi alluvium lying within the Study Area. All floodplains of the commercial forest area, except possibly those of the prairie sections, will produce factory grade logs under high-level forest management. In 1962, the level of management of bottomland hardwoods was generally poor. The average volume of all merchantable sawlogs was 1,800-2,000 board feet per acre. The average volume of factory grade logs was considerably less. In the average stand, the best growing stock consisted of saplings and polesize trees, and about thirty percent of the growing space was occupied by cull trees, or competing vegetation.

Wood Pulp and Paper Industry

The pulp and paper industry has been a very important addition to the forest industry of the Study Area. The introduction and expansion of this segment of the industry has opened another door in National markets. A market for small material made more intensive forest management feasible for other forest industry and non-industrial forest landowners. The small forest landowner has been given the opportunity for more immediate returns from his forest land and management activities. The market provided by the pulp industry was the primary factor in the large pine planning program that took place on the Red River Basin and adjacent areas. The sale of chipped residues has improved utilization and chances for profits for sawmills and other wood manufacturing plants.

The first successful Kraft papermaking operation in the states of Arkansas, Louisiana, Oklahoma, and Texas started at Bogalusa, Louisiana, in 1918. The Springhill, Louisiana, mill established in 1938, was the first in the Study Area. A large mill was established at Hodge, Louisiana, adjacent to the Study Area, in 1927. Several small mills,utilizing mostly hardwoods to produce roofing felt and wall board materials, were established between 1949 and 1960.

The production of pine pulpwood on the Study Area has followed a generally steady rise between 1950-62. The volume of hardwood pulpwood produced doubled during this period. Table 29 shows the 1962 production

of pulpwood. An additional 9,739,000 cubic feet of pine mill residues were chipped for wood pulp. Pulpwood was 36.8 percent of all industrial roundwood production.

The 1962 average daily production of mills in the Study area was 1,660 tons of pulp. Almost all this pulp was processed into Kraft paper and container board. Approximately 60,000 tons of the annual production were converted into containers and other finished products by secondary manufacturing facilities.

On-farm Use

Integrated wood lots have always been a convenient and economical source of wood products for use in overall farm management. This source of supply is especially important to the small, family type operation. The 1962 production of material used on-the-farm in the Study Area was as follows:

State	Volume 1/ -1,000 Cubic Feet		
	Pine	Hardwoods	Total
Arkansas	70	318	388
Louisiana	100	577	677
Oklahoma	47	555	602
Texas	53	208	261
Total	270	1,658	1,928

1/ Not included in Table 28

Forest Based Economic Activity

In 1962 industrial roundwood (table 29) produced on the Study Area had a total stumpage value of $12,447,389. The value of these raw products delivered at mills and processing plants on the base area was $33,494,271.

Of the value added in primary manufacturing $57,507,997 was attributable to 1962 wood production from the Study Area. An additional $31,473,542, attributable to Study Area timber, was added in secondary manufacturing processes on the base 1/ area. Data on values attributable to timber in transportation and marketing of finished products, and in the construction field are not available.

In 1962, 14,143 full-time workers in forest management and forest-based industry whose employment was directly attributable to timber resources of the Study Area, earned a total of $52,540,880 in wages and salaries. The bulk of these earnings are costs of harvesting

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1/ Whole counties and parishes of the Basin Study Area, except Panola County, Texas

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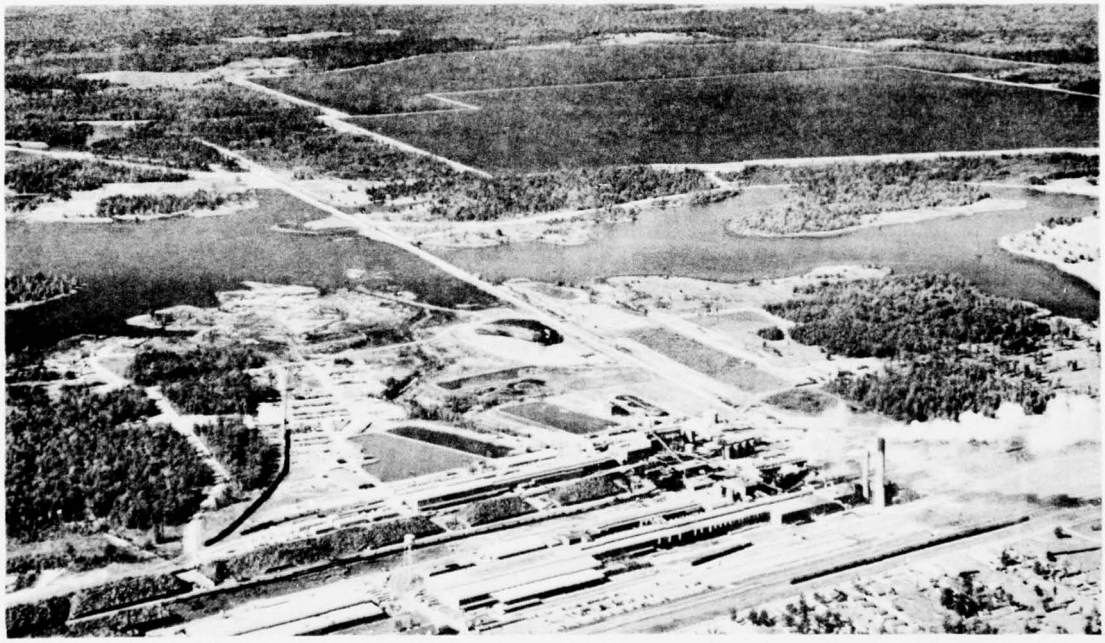
A professional forester advises the owner of well-managed private forest lands, on an upland site managed essentially for pine species. (U. S. Forest Service Photo)



A partial view of the pulp and paper mill at Springhill, Louisiana. Impounding basins and fresh water lakes in the background are used in effluent disposal. (Photo Courtesy International Paper Company)

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and processing stumpage, and appears as value added in data given in the preceeding paragraphs. This economic activity was confined to the base area.

Total employment in forest management and forest industry on the base area was 20,703 full-time jobs for 1962. Wages and salaries earned by this work force totaled $73,861,808.

Forest Productivity and Technology

Projected National Consumption

A comprehensive study 1/ by the USFS of trends in consumption of industrial wood in the United States, shows an actual consumption of limber in 1962 of 35 billion board feet and a projected consumption of 55 billion in 2010. The bulk of the lumber used in 2010 is shown to be domestic softwood.

The same report shows plywood and veneer consumption in 2010 as over 25 times the 1962 production. Softwood plywood is expected to supply about 79 percent of the 2010 consumption.

"Timber Trends" 1/ shows a 2010 consumption of pulpwood more than triple that of 1962. Imports are expected to furnish a relatively minor part of the total supplies during the 1970-2010 period. Domestic hardwoods are expected to furnish about 45 percent of the total roundwood for pulping.

Study Area Interim Development and Productivity

Figure 9 shows the actual production of lumber, roundwood pulpwood, and chipped wood residues for the South in the 1961-66 period. Similar data is shown for softwood plywood production in the U. S.

Softwood lumber production in the South increased 13-1/3 percent from 1962 to 1966. The increase in production on the Study Area was about 20 percent for the same period. The transition of forest industry on the Study Area from small mills to medium and large modern mills has increased efficiency in manufacturing and resulted in higher quality products. The increasingly diversified forest industry is producing (1967) more and more of the building materials (paperboard, particle board, softwood plywood) that are displacing lumber in some sectors of the market.

1/ "Timber Trends in the U. S.", Forest Resource Report No. 17, U. S. Forest Service, 1963.

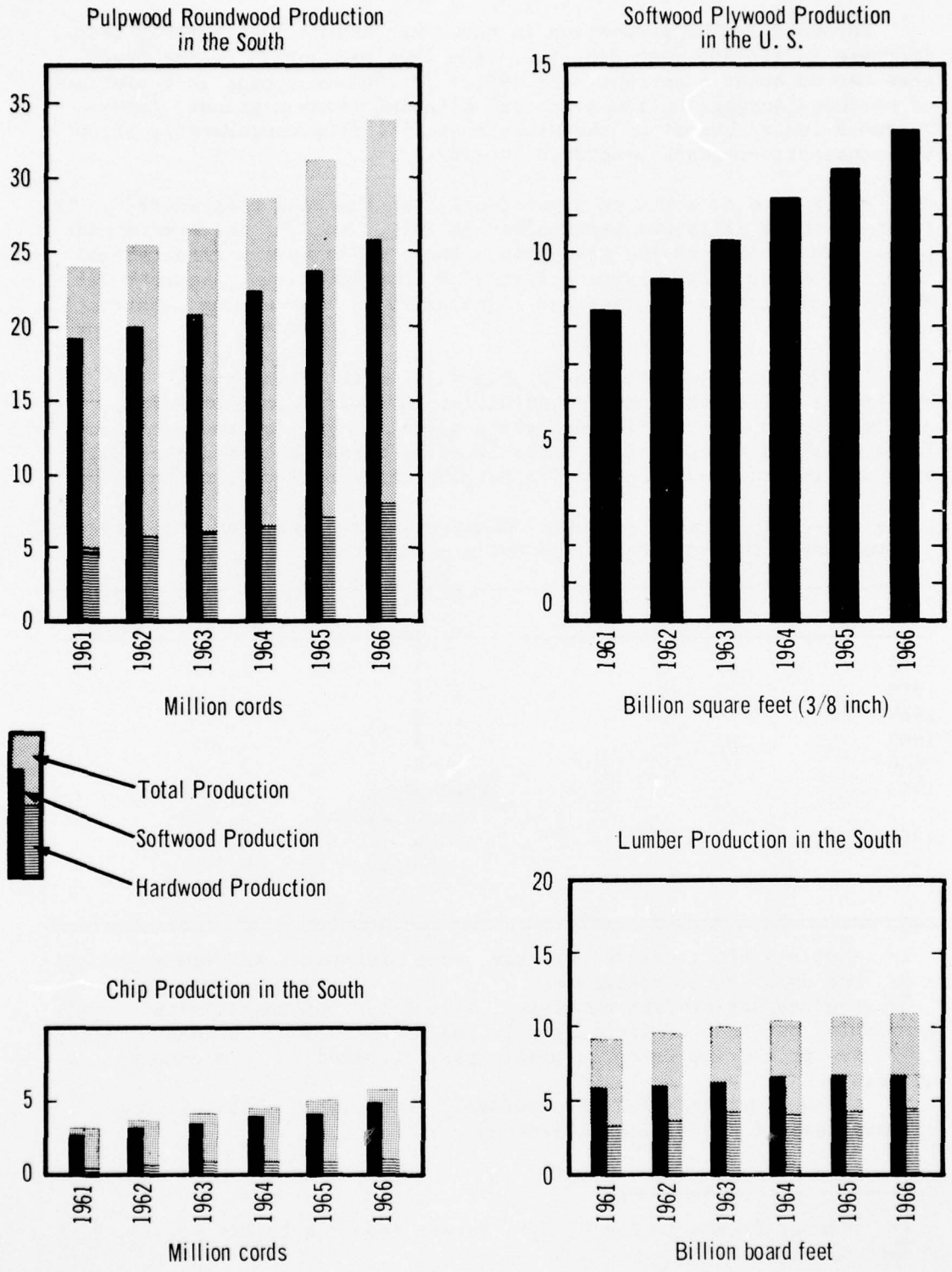

Figure 9

CURRENT WOOD PRODUCTS PRODUCTION

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Hardwood lumber production in the South showed considerably less increase in 1961-66 than did pine. The 1966 production on the Study Area was up about 5 percent over 1962. If 1963-66 trends in conversion of hardwood acreage on the principal alluvial lands continue, future hardwood lumber output on the Study Area will drop considerably below the consumption trends predicted in 1962 1/.

There were no softwood plywood mills on the base area in 1962. The first of these mills was established in 1964. In 1967 there were nine pine plywood mills on the base area. These mills have a total annual capacity of 640 million square feet (3/8 inch material). Another mill of 50-60 million square feet annual capacity is planned for construction by 1970.

In 1962 there was one large pulp mill on the Study Area. Two additional mills were under construction in 1966. Final planning, preliminary to construction is taking place in 1967 for two additional large pulp and paper mills. Table 30 shows actual and estimated pulp mill development and increases in pulping capacity from 1962 to 1980.

Table 30 - Pulp 1/ and Paper Mill Development to 1968, and Expected Development to 1980, Red River Basin Study Area

Year	Number of Mills	Daily Production 2/ (tons of dry pulp)
1962	3	1,750
1963	3	1,750
1964	3	1,770
1965	3	2,045
1966	3	2,075
1967	(Two under construction)	2,100+
1968	5	3,300
1975	8 3/	4,600 4/
1980	9	5,900 5/

1/ Mostly Kraft (sulfate) process, some mechanical and semi-chemical
2/ Per 24 hours of operation
3/ Engineering studies completed, mill sites purchased, water supply available, purchase of timber supply lands continuing in 1968, 3 mills
4/ New production based on preliminary information from company officials
5/ Allows for expansion of previously established mills up to a minimum level for efficient operation

1/ "Timber Trends in the U. S.", Forest Resource Report No. 17, U. S. Forest Service, 1963.

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Projected Growth, Cut, and Inventory

Table 31 shows the projected cut, growth, and inventory of growing stock for 1980 and 2010, as well as that for the base year.

Table 31 - Timber Cut, Growth, and Inventory of Growing Stock in 1962, and Projections to 1980 and 2010, Red River Basin Study Area

Year	Cut			Growth			Inventory		
	All Species	Soft-woods	Hard-woods	All Species	Soft-woods	Hard-woods	All Species	Soft-woods	Hard-woods
	million cubic feet								
1962 1/	169	116	53	346	242	104	5,667	3,090	2,577
1980 2/	311	218	93	469	332	137	9,733	6,027	3,706
2010 2/	616	456	160	396	262	134	7,562	4,194	3,368

1/ Volume based on Forest Survey Reports: Arkansas 1959, Louisiana 1954 and 1965, Oklahoma 1956, and Texas 1955 and 1965. Data was adjusted to 1962 level. County data was prorated to basin portion by commercial forest land area.

2/ Projections based on regional trends of supply and demand presented in Timber Trends in The United States, Forest Resource Report No. 17, and modified by historical trends and other local factors on the basin area.

Table 32 shows 1980 and 2010 projections for sawtimber cut, growth, and inventory. Figure 10 illustrates, and compares, cut and growth for 1962, 1980, and 2010. According to these projections 1/ the expected cut of growing stock begins to exceed growth sometime in the 1980 and 2010 period. These projections are based on the 1962 level of management.

Table 32 - Timber Cut, Growth, and Inventory of Sawtimber in 1962, and Projections to 1980 and 2010, Red River Basin Study Area

Year	Cut			Growth			Inventory		
	All Species	Soft-woods	Hard-woods	All Species	Soft-woods	Hard-woods	All Species	Soft-woods	Hard-woods
	million board feet								
1962 1/	657	431	226	1,275	1,052	223	20,275	13,109	7,166
1980 2/	1,064	840	224	1,623	1,371	252	31,074	23,858	7,216
2010 2/	1,932	1,624	308	1,440	1,213	227	25,000	19,313	5,687

1/ Volume based on Forest Survey Reports: Arkansas 1959, Louisiana 1954 and 1965, Oklahoma 1956, and Texas 1955 and 1965. Data was adjusted to 1962 level. County data was prorated to basin portion by commercial forest land area.

2/ Projections based on regional trends of supply and demand presented in Timber Trends in The United States, Forest Resource Report No. 17, and modified by historical trends and other local factors on the basin area.

1/ "Timber Trends", U. S. Forest Service

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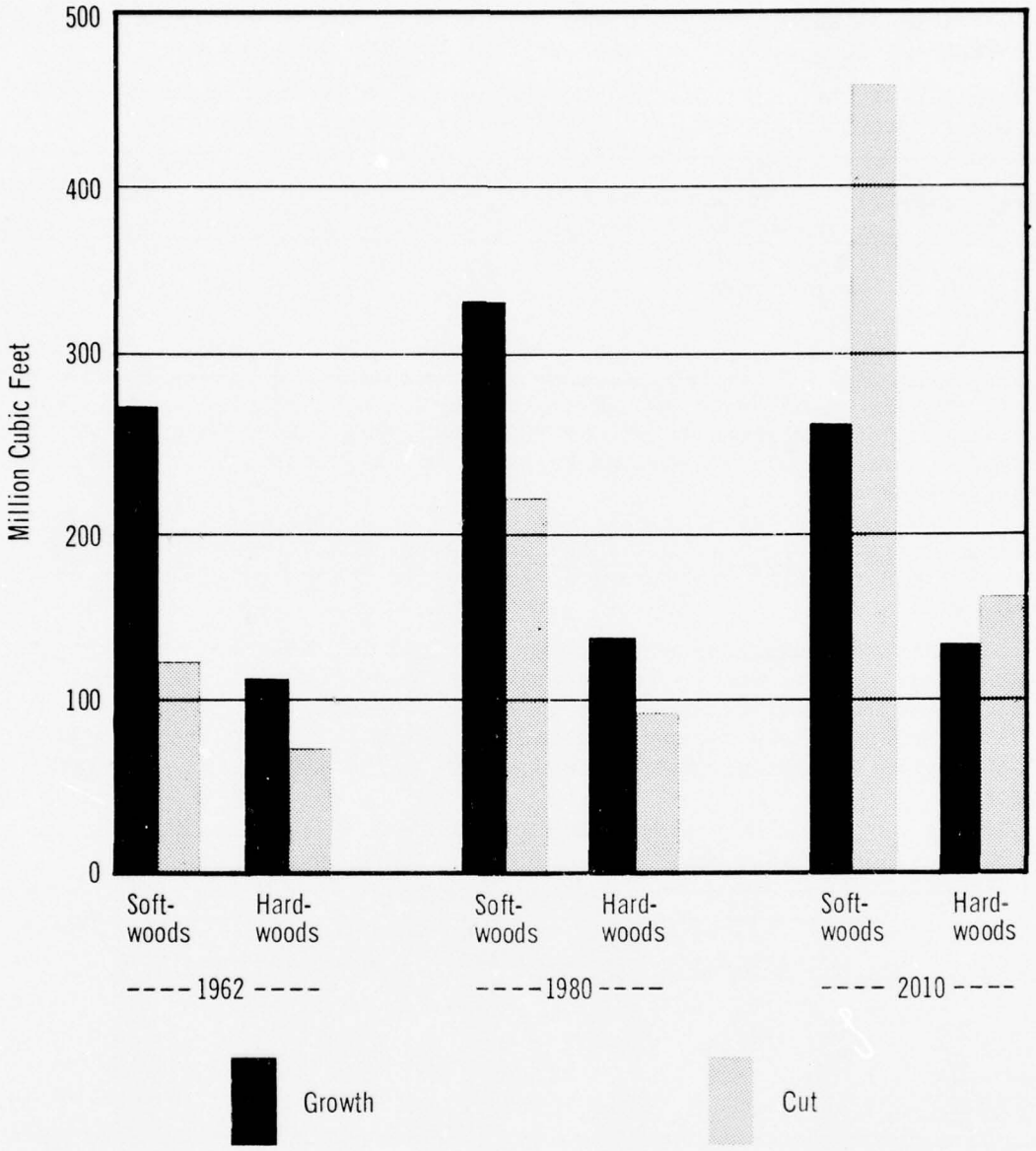

Figure 10

COMPARISON OF 1962 AND EXPECTED CUT AND GROWTH BY SPECIES GROUPS, AT THE 1962 LEVEL OF MANAGEMENT, RED RIVER BASIN STUDY AREA

Recent (1966) reports indicate that the actual cut is significantly exceeding that established and projected 1/ from 1962 information 2/. The origin in 1964 of the southern pine plywood industry, and its subsequent rapid expansion in the Study Area in 1965-1966, has made unforeseen inroads on inventories and is affecting the cut-growth relationship. The cut and growth relationship for hardwoods, as projected from 1962 information, has been affected by large scale land clearing that has occurred on major alluvial areas of the Study Area since 1962. A considerable acreage of hardwood timber has been taken out of production.

Since 1962, established forest industry has been acquiring non-industry forest lands (particularly pinelands) in the Study Area. These lands have been effectively acquired by extended cutting contracts, long-term leases, and outright purchase. This will result in improved forest management and increased production, and will tend to alleviate the unexpected (in 1962) drain on inventories. Further improvements in utilization would also extend future supplies somewhat, with the current level of forest management. Evidence at present (1967), however, indicates that forest industry on the Study Area will further expand its manufacturing capacity in response to future rises in National demand and improved market conditions. The growth and inventory made available by the 1967 level of management is not expected to sustain industry on the area through the period of this Study.

Forest Technology

The manufacturing plants in the Study Area have been modernized and are capable of competing with those of other supply areas. Improved forest management is necessary on much of the nonindustry private forest lands, if the timber resource is to adequately sustain forest-based industrial expansion in response to increased National damands.

Stumpage prices on the Study Area have responded to increased demand generated by new manufacturing plants. Augmentation of demand by mills under construction in areas of previously weak demand will substantially reinforce markets in these areas. Sound forest management, keyed to the inherent productivity of the lands concerned, should repay initial costs within a reasonable period, increase land values, generate additional sustained revenue, and offer expanded economic opportunities for the future.

Where small forest landowners are concerned, cooperative management ventures seem to offer the best chance for continuous professional-level advice and supervision at acceptable costs. For the landowners

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1/ Guided by "Timber Trends in the U. S.", Forest Resource Report No. 17, U. S. Forest Service

2/ State Forest Survey reports

AD-A036 750 RED RIVER BASIN COORDINATING COMMITTEE NEW ORLEANS LA F/G 8/6
COMPREHENSIVE BASIN STUDY. RED RIVER BELOW DENISON DAM, ARKANSA--ETC(U)
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with highly productive forest land, though of limited acreage, this arrangement offers worthwhile economic returns.

The logging industry is a sector where improvement is imperative for the economic health of forest industry as a whole. If operators and employees in the logging field are to get their share of the future wood dollar, production costs must be lowered substantially. Improved planning and organization, increased mechanization, improved equipment and increased employee skills are needed for most of these operations. The distribution and volume of available supplies of timber is an important consideration in the methods and equipment to be used.

The use of satellite processing stations to supply large pulpmills is an innovation that reduces transportation costs and simplifies wood storage problems and preliminary processing at the parent mill. Material can be debarked, chipped, screened, and then loaded pneumatically or by mechanical conveyer into rail cars. The material is ready for the pulp digestor when it arrives at the mill.

Stumpside chippers may be used to eliminate skidding. Roadside chippers could prove feasible where large volumes are harvested with a minimum of shifting of equipment and would improve utilization.

Tree-length logging for sawlogs, with roadside sorting, offers advantages in utilization and increased return from stumpage. Careful planning and imagination will be needed to develop methods of more productive wood harvesting.

Oak and similar "hard" hardwood species are being used (1967) extensively in papermaking in some sections of the southeastern United States. The increased pulping of such species for particle board and paper would permit the utilization of large areas of upland hardwoods, now bearing stands poorly merchantable for sawlogs. This would produce needed income for landowners and materially extend industrial wood supplies. Pulpwood sales could be used to remove low-quality portions of bottomland hardwood stands, while retaining ample growing stock of desirable species and quality for a sawlog stand.

On productive sites, plantations of cottonwood and sycamore, worked on short rotations, appear feasible. Pole-size sycamore can be chipped and processed for paper without debarking. If chipping at stumpside is added to such an operation, pulp material could be harvested in very short rotations and would provide a rapid return of capital.

Marketing

Rising National demand for wood products and the rapid establishment of large, modern softwood plywood plants on the Study Area and base area since 1962 have strengthened the pine sawlog stumpage market (see exhibits 12 and 13). Pulp and paper mills now under construction and committed to construction will substantially augment pulp stumpage

markets throughout the Study Area. The increasing scarcity of high-grade hardwood logs is a definite factor in rising stumpage and log prices (exhibits 12 and 13).

For best results, forest landowners should sell stumpage at, or after, financial maturity. Intermediate cuts should yield the highest value in a combination of immediate returns and improvement of the remaining stands. Saleable trees should be offered to all producers. Combination sales to improve the return on high-demand material such as piling and veneer logs should be considered. Small owners of adjacent lands should consider combined sales in order to demand top market prices. Ownerships combined in one plan and managed cooperatively in sustained yield could readily adopt this method. As logging operations become more mechanized, value of low-volume stumpage will be discounted to cover higher equipment operating cost and depreciation.

Most of the lumber manufactured by mills in the Study Area is now finished, trimmed, and packaged before shipment. Most finished material is protected from the weather during shipment. Such merchandizing is attractive to wholesalers and consumers (see exhibits 14 and 15 for 1961-66 lumber prices). Well-finished dimension material has a special utility in the construction field in raising the productivity of high-cost labor. The paper industry can be expected to add more variety to its products as market opportunities occur and mill capacity becomes available. With the processes and techniques now available, almost any paper product can be manufactured from available wood-fiber materials. To remain competitive in the future, forest industry must give merchandizing and customer service the same careful attention given forest management and plant operation.

WATER AND RELATED LAND RESOURCE PROBLEMS

WATER RESOURCE PROBLEMS

The diversity of soils, topography, land use, annual rainfall, types of agriculture, and distribution of population in the Study Area are some of the factors related to various problems that were considered in this comprehensive study. Problems were investigated in each of the 193 CNI watersheds in the 24 tributary basins.

Flood Problems

Flooding is a major problem on the alluvial soils of the Red River and its tributaries. Average annual precipitation in the Red River ranges from about 39 inches at Durant, Oklahoma, to approximately 60 inches at Alexandria, Louisiana. The average annual amounts of moisture are adequate to produce satisfactory agricultural yields, but the problem concerns rainfall distribution for efficient use.

Flooding in the Red River Alluvium was investigated only where flood problems occur in association with other problems such as inadequate drainage or drought. Flooding in the Red River Allumium is caused by headwater runoff and also backwater from the Red River during high stages. Damages in the Red River Alluvium from flooding by Red River were evaluated by the USAE and are not included in these damage estimates.

The major flood damage on agricultural land is to crops and pastures. The flood problem is most severe on floodplains of high productivity and intensive use. Such soils may be found in the Southern Mississippi Valley Alluvium and the Texas Blackland Prairie.

Floodplains in the Southern Coastal Plain LRA are generally used for a less intensive type of agriculture with a major portion in woodland and flood problems are only moderate. The Ouachita Mountains LRA includes a small percentage of floodplain and problems from flooding are of a minor nature. There is a small amount of open land and scarcely any cropland along the narrow valleys. There are few problems from flooding in the other land resource areas, which comprise a minor portion of the Study Area.

Other problems to agriculture from flooding include livestock losses, damages to fences, levees, and farm equipment. Nonagricultural flood problems are primarily from damage to roads and bridges. Damages occur most frequently to county or secondary roads. Highways with asphalt surface pavements are also damaged by inundation for extended periods, although all of the damage often does not become apparent for several months after the flood.

Problems are encountered where flooding occurs within the corporate limits of a town, or city, and this is classed as urban damage. The problems may affect either residential areas or business establishments

Cropland and Pastureland Flooding
Southern Mississippi Valley Alluvium, Caddo Parish, Louisiana

Red River Bank Caving Encroachment on Cotton Field--Caddo Parish, Louisiana

4-24879

or both. Examples of such problems are found in a number of towns scattered throughout the Study Area. Normal growth and development is retarded in areas with this problem.

Floodplain erosion problems occur frequently. These are always associated with other floodwater problems. The greatest of these concerns the forming of scour channels in the floodplain. Severity of scour damage is correlated with depth of water flowing over the land.

Erosion of streambanks is of minor importance except along the main stem of Red River and in isolated cases elsewhere. Bank stabilization studies for the Red River have been made by the USAE. The most extensive other area of channel enlargement is along Upper North Sulphur River in the Sulphur River Tributary Basin.

The most prevalent sediment problem is deposition on floodplain land. It results in decreased production yields of crops and pasture from existing yield potential in the absence of sediment damage. Sediment problems also occur from deposition in reservoirs. This necessitates inclusion of additional capacity for sediment storage in design of reservoirs.

Sediment Deposits up to 16 inches in Depth from one Flood--Bossier Parish, Louisiana

Other problems are encountered and include certain indirect losses which result from flooding even though the property involved was not flooded. Some examples include loss of business due to interruption and rerouting of traffic, value of extra feed required for livestock, and food spoilage as a result of flooding.

Land use and flood damages were estimated to determine the magnitude of the flood problem in each CNI watershed. In watershed investigations, the floodplain was defined as the maximum area which would be inundated by floodwater, without project conditions, by a storm of approximately 25-year expected frequency. Floodplain area estimates were prepared for all CNI watersheds. An estimated floodplain area of 77,746 acres occurs in watershed projects authorized for construction prior to December 31, 1962. Floodplain major land use for each of these CNI watersheds is summarized in Exhibit 16.

Flooding is a problem on about 1,132,136 acres of floodplain in watersheds considered feasible for development and initiation of construction within 10-15 years. Floodplain major land use by tributary basins and CNI watersheds in this category are summarized in Exhibit 17.

Flooding is a problem on approximately 78,150 acres of floodplain in six watersheds that are considered feasible for development after 10-15 years. Floodplain major land use is summarized for each of these watersheds in Exhibit 18.

The remaining floodplain consisting of 1,761,858 acres is in watersheds considered not feasible for development at this time. This area is primarily woods and pasture with flood problems of minor nature. Floodplain major land use for each of these watersheds is summarized in Exhibit 19.

Average annual flood damages were compiled from Public Law 566 Watershed Work Plans, data developed during selected watershed detailed investigations, and data developed during field examination scope studies in the remaining watersheds. Floodwater, sediment, erosion (floodplain scour), and indirect damages are estimated at $9,639,600 annually, exclusive of damages on major floodplains investigated by the USAE. These annual damages will be reduced to $8,513,665 by upstream watershed projects authorized prior to 1963.

Flood damage problems are greatest in CNI watershed groups in which planning and construction have already been initiated and those which are feasible for project development and initiation of construction within 10-15 years. About $7,619,420 or approximately 78 percent of all flood damages occur in these watershed groups. Flood damages for each watershed of each group are included in Exhibits 20 and 21. These damages are summarized for each group of watersheds in Table 33.

Flood damages in the group of six watersheds considered feasible for project development after 1980 average $211,580 annually. The group of watersheds that is not considered to be feasible for development also contribute to total flood damages. Average annual flood damages are estimated at $1,808,600 for the latter group.

Table 33 - Estimated Average Annual Flood Damages, Red River Basin Study Area

Watershed Group	Floodwater: Agricultural	Floodwater: Nonagricultural	Sediment	Erosion	Indirect	Total
	- - - - - - - dollars - - - - - - -					
Watersheds authorized for operations	914,090	146,270	73,560	116,460	127,260	1,377,640
Watersheds feasible for development by 1980	5,291,345	380,410	114,625	139,440	315,960	6,241,780
Total	6,205,435	526,680	188,185	255,900	443,220	7,619,420

Inadequate Drainage Problems

Drainage includes works of improvement installed for the purpose of lowering the water level in areas that under natural conditions are swamps, marshes or lakes, or in areas where normal precipitation, seepage, or excess irrigation water keeps soil too wet for sustained agricultural use. A large portion of the area with flood problems is also considered to have drainage problems. These are incidental to problems of flooding and occur only so long as flood problems persist.

Cotton Crop Damaged by Inadequate Drainage near Natchitoches, Louisiana

4-24879

In flatlands, the problems of inadequate drainage are considered inseparable from problems of flooding due to their interrelationship. Thus, the acreage with drainage problems is considered to have a combined problem of inadequate drainage and flooding.

A tabulation of acreages with a combined drainage and flood problem reveals approximately 4,822,400 acres in this category. An inventory of the acreage with a drainage and flood problem by land use and tributary basins in shown in Table 34.

Table 34 - Drainage and Flood Problem Areas by Tributary Basins and Major Land Uses, Red River Basin Study Area

Tributary Basin	Drainage and Flood Problem Area			
	Cropland	Pasture	Woodland	Total
	- - - - - thousand acres - - - - -			
Barkman Creek	4.9	2.5	14.2	21.6
Bayou Jean de Jean	0.2	0.5	16.6	17.3
Bayou Pierre	41.8	77.1	165.3	284.2
Bayou Rapides	8.1	16.1	8.8	33.0
Bayou Rigolette	7.8	15.8	47.6	71.2
Black and Saline Lakes	1.8	16.0	172.6	190.4
Blue River	1.3	3.4	10.7	15.4
Boggy Creek	16.3	22.7	105.7	144.7
Bois d'Arc Creek	3.1	5.5	33.2	41.8
Cane River	7.3	40.7	110.6	158.6
Chatlin Lake and Associated Area	80.6	87.1	231.2	398.9
Cypress Creek	69.9	93.0	337.1	500.0
Kiamichi River	5.0	24.9	75.1	105.0
Little River	13.3	39.9	298.4	351.6
Loggy Bayou	41.4	41.1	516.4	598.9
Maniece Bayou	3.2	9.7	20.7	33.6
McKinney Bayou	17.8	10.8	73.9	102.5
Intervening Areas - Arkansas and Oklahoma	28.9	51.7	85.7	166.3
Intervening Areas - Texas	109.4	39.6	227.1	376.1
Nantachie Creek	0	0.3	10.1	10.4
Posten Bayou	20.1	6.6	15.9	42.6
Red River Backwater Area	17.8	23.6	363.3	404.7
Red River Main Stem	9.1	26.5	72.1	107.7
Sulphur River	136.7	131.0	378.2	645.9
Total	645.8	786.1	3,390.5	4,822.4

4-24879

Drainage and flood problem areas exist in all land resource areas. The Southern Mississippi Valley Alluvium and Southern Coastal Plain LRA contain 85 percent of the drainage and flood problem area with the Southern Mississippi Valley Alluvium LRA containing the greater amount.

Drought and Irrigation Problems

Drought problems vary from year to year. Although there has been some supplemental irrigation in the basin by individuals for many years, the practice was intensified during the drought of 1956.

Although the average annual precipitation is adequate for satisfactory yields of crops and pasture throughout the Study Area, its untimely distribution greatly increases the risks involved in agricultural production, thereby bringing about the desirability for supplemental irrigation. All irrigation, except for rice, is classed as supplemental.

Data on current irrigation development, totaling approximately 42,000 acres in the Study Area, are summarized in the Irrigation Appendix. About 34,000 additional acres have been irrigated previously. Rice, the predominant irrigated crop, comprises over 60 percent of the irrigated area in Louisiana. Other major crops on land with drought problems are cotton, alfalfa, corn, and pasture. In Oklahoma and Texas, supplemental irrigation has been extended to peanut acreages.

Water Quality Control Problems

Extensive water pollution stems from natural, municipal, industrial, and agricultural sources. With the population increase and industrial growth predicted for the area, pollution problems will become more acute unless corrective action is taken.

Salt from natural sources above Lake Texoma creates pollution problems in Red River below Denison Dam. Ten significant natural brine emmission areas have been located by the Public Health Service 1/. Five source areas are located on the Prairie Dog Town Fork tributary, three are on the Wichita River tributary, one is on the Pease River tributary, and one is on the Elm Fork tributary.

Turbidity, caused by sediment, is objectionable for esthetic and other reasons. It is detrimental because it inhibits the growth of plants important to fish food, and it renders the water unsuitable for many municipal and industrial uses.

1/ Figure IV-6, Arkansas-Red River Basins, Water Quality Conservation, Appendix Volume I; U. S. Department of Health, Education, and Welfare, June 1964.

4-24879

Municipalities pollute streams primarily through sewage waste disposals. The available oxygen in water is used for decomposition of organic wastes. Where large quantities of wastes are dumped into streams, the oxygen content of the water can fall below a critical point needed for survival of fish. When this happens, even for a short period of time, a fish kill will result.

Paper mill, poultry processing plant, and oil field effluents are the principal causes of both local and far-reaching pollution problems. In the manufacturing process, woodpulp mills take in large quantities of good quality water and cast off similar quantities of polluted water. Effluent from processing plants intensifies the presence of disease-causing organisms. Brine from oil field operations kills all vegetation and renders water unfit for nearly all uses.

Agricultural practices cause several pollution problems. The erosion of tilled land increases turbidity. Insecticides, herbicides, and chemical fertilizers from treated fields sometimes contaminate natural streams. In some areas, irrigation return water with high concentrations of soluble salts impairs water quality in receiving streams.

The FWPCA evaluated all water quality problems. Their studies are covered in detail in Appendix XI.

Recreation Problems.

Inadequate water areas and associated recreation facilities are recreation problems. The Study Area has large areas of surface water, but the distribution is inadequate to meet water-orientated recreation needs. For example: Lake Texoma is adjacent to Denison and Sherman, Texas, and Durant, Oklahoma. However, the needs for water and associated recreational facilities are evident in the CNI watersheds in which these cities are located. The increasing population and greater individual participation compounds the recreation problem. BOR studies indicate that problems will be intensified in future years.

The increasing use made of areas open to public hunting shows clearly the great need for additional such areas. National Forest lands, state-owned hunting areas, and those privately-owned areas open to public hunting, cannot meet the demand. There is a clear and increasing need for the development of hunting opportunities on private lands, now closed to public use.

As the population increases and urban living becomes more organized, the demand for forest-oriented recreation will grow. Areas of National Forests and state parks and forests will continue to be developed for such recreational use; however, the demand within the period of this study report may well exceed the expected capacities of these areas. Table 35 shows the 1958 to 1965 trends in use of developed recreational areas on National Forests and National Grasslands in the Study Area. Too-heavy use or overcrowding on such areas detracts from the recreational experience for many users. The

development of forest areas for recreational use offers an economic opportunity to private landowners.

Table 35 - Use of Recreational Facilities on National Forests System Lands on Base Area

	National Forests			National Grasslands		
	1958	1962	1965	1958	1962	1965
	visitor-days 1/ of actual use					
Camping	26,400	47,350	245,043	-	550	900
Picnicking	53,075	102,702	217,981	1,800	2,500	2,500
Swimming	20,450	40,070	52,424	2,500	-	-
Boating	4,500	12,274	15,815	3,000	600	550
Hiking and Scenic Areas	27,837	52,867	55,885	-	-	-
Total	132,262	255,263	587,148	7,300	3,650	3,950

1/ Equivalent to 12 hours use by one individual (different individuals may be involved in any one visitor-day's use)

Water Supply Problems

Municipal and Rural Community

During field examination scope studies, inquires were made regarding existing or potential shortages of water supply for municipal or industrial use, in an effort to identify water supply problems. Water supply problems are also described in the PHS Publication 775 (latest revision) "Inventory Water Facilities". The FWPCA developed projected municipal and industrial water supply needs. These are covered in detail in Appendix XI.

Almost all of the cities and larger towns in the Study Area obtain their water supply from surface storage in reservoirs. A few towns obtain their water directly from streamflow. Bossier City, Louisiana, and Durant, Oklahoma, pump water from Red River and Blue River, respectively. Wells are the source of water for rural residents and smaller towns and communities. Lack of water supplies dependable for sustained use may cause industry to hesitate to locate in some towns. These problems were recognized in developing several P. L. 566 watershed work plans.

Forest Industry

Water supplies for potential development of forest industry are recognized as a problem. The heavy users of consequence are the pulp and paper mills. Other forest industry is usually supplied by local or municipal systems without excessive drain on the source.

The USFS inventoried present and foreseeable needs by established pulp and paper mills in the Study Area. These data were developed from estimates by plant managers and studies of pulp and paper making by the USGS and others. In developing possible future water needs, pulp and paper mills for full utilization of the wood raw material were considered as built. These establishments have been suggested or recommended by recent engineering studies and by studies made by public agencies interested in forest utilization. (These studies assume that per capita paper consumption will continue at the level necessary to absorb all products supplied by the basin area.) Construction of all proposed mills was considered to be feasible by the year 2000. In setting water needs by future installations of heavy forest industry, allowances were made for subsequent expansion and increased production as a result of improved efficiency. Water supply problems represented by these present and apparent future needs were brought to the attention of the FWPCA for developing data for the Appendix XI and are shown in Exhibit 22.

LAND RESOURCE PROBLEMS

Erosion, Soil Limitation, and Excess Water Problems

Land resource problems were classified into three general categories. The major problem is soil erosion. Excess water and soil limitations in the root zone are two lesser problems. Extent of problems was estimated by major land uses and land capability subclasses.

Unprotected Cropland Sheet and Gully Erosion

4-24879

Subclasses were not recognized in land capability Class I. All other land capability classes were divided into appropriate subclasses to identify the land resource problems. Subclass (e) includes soils that have limitations in use because erosion is the dominant problem or hazard. Soil erosion susceptibility and past erosion damage are the principal factors for placing soils into this subclass.

Subclass (w) includes soils that have limitations in use because excess water is the dominant problem or hazard. Soil wetness, high water table, overflow, and poor drainage are factors for placing soils into this subclass.

Soils with root zone limitations as the dominant hazard or limitation in use were included in subclass (s). Factors such as shallow soils, stoniness, low-moisture-holding capacity, low fertility that is difficult to correct, and salinity or alkalinity limit root zones in this subclass.

The dominant kind of soil problem or hazard that affects limitation in land use determined the subclass into which soils were placed. Where two kinds of soil problems or hazards that can be modified or corrected are essentially equal, soils were included in subclasses according to the priority (e), (w), and (s). For example, in parts of the Study Area, land use may be limited equally by erosion and excess water problems or hazards. In such cases, soils would be included in subclass (e) and would not be included in subclass (w).

Major land use distribution by land capability subclasses is a primary factor in determining the scope and magnitude of land resource problems. An inventory of land capability subclasses by major land uses is shown in Table 36.

Of the 17,333,300 acres in the inventory area, about 16,559,800 acres are included in land capability subclasses that have either erosion, soil, or excess water problems. Soil erosion is the major problem. It affects almost 51 percent of the entire acreage of the land resource problem area. Excess water and soil condition problems affect about 31 and 18 percent, respectively, of the entire problem area.

Soil erosion problems are concentrated in land capability classes that are capable of producing cultivated field crops. About 79 percent of the erosion problems occur on soils in Land Capability Classes I to IV and only 21 percent occur on the land area that is best suited to native vegetation. Soil condition problems exist predominantly on land that is best suited to native vegetation. The excess water problems exist entirely on land resources that are capable of producing field crops and pasture plants if the hazard were removed.

Land resource problems vary considerably by states. Tabulations showing land capability classes by states and land resource problems by subclasses are included in Exhibit 23.

Table 36 - Land Capability Subclass Distribution by Major Land Uses, Red River Basin Study Area, 1962 Conditions

Land Capability Class and Subclass	Cropland	Grazing Land	Woodland	Miscellaneous Land	Total
			thousand acres		
Subclass IIe	765.7	435.7	754.0	85.5	2,040.9
Subclass IIIe	1,048.9	855.3	1,388.5	127.6	3,420.3
Subclass IVe	157.4	267.8	675.5	45.1	1,145.8
Subclass VIe	28.7	154.7	807.8	63.8	1,055.0
Subclass VIIe	64.5	138.3	533.5	5.0	741.3
Subtotal	2,065.2	1,851.8	4,159.3	327.0	8,403.3
Subclass IIs	343.7	111.4	126.8	8.2	590.1
Subclass IIIs	57.0	29.9	138.8	7.8	233.5
Subclass IVs	4.4	5.4	21.7	3.9	35.4
Subclass VIs	0.9	2.8	16.0	-	19.7
Subclass VIIs	0.1	204.8	1,949.7	5.7	2,160.3
Subtotal	406.1	354.3	2,253.0	25.6	3,039.0
Subclass IIw	190.6	162.2	319.6	21.7	694.1
Subclass IIIw	218.5	261.7	772.4	14.3	1,266.9
Subclass IVw	26.9	60.3	575.3	1.6	664.1
Subclass Vw	105.1	323.2	2,044.1	20.0	2,492.4
Subtotal	541.1	807.4	3,711.4	57.6	5,117.5
Total	3,012.4	3,013.5	10,123.7	410.2	16,559.8

Sedimentation

Sediment production rates per unit of area are related to the size of the drainage area contributing the sediment. A distinct trend toward lower rates of production per unit of area is evident as the drainage area increases in size. Table 37 shows average rates of sediment production per square mile by LRA and the variations in the rates as related to the size of the drainage areas.

Sediment produces detrimental effects other than those associated with flooding and reservoir sedimentation. Water pollution caused by sediment in stream transport is a significant problem in water quality control. Municipal and industrial water users generally must process stream water prior to consumption; costs for these purification processes are affected depending upon the amount of suspended and colloidal sediment load.

Sediment concentrated in stream water sometimes results in reductions in the fish population because of strangulation of some species.

Aside from the unattractiveness of muddy water, costs are incurred in maintaining the cleanliness of recreational use facilities.

Table 37 - Relation of Average Annual Rate of Sediment Production to Land Resource Area and Drainage Area Size - Red River Basin Study Area

Land Resource Area	Drainage Area	Sediment Production Rate
	square miles	acre-feet/square-mile/year
Central Rolling Red Prairies	1	0.94
	10	0.75
	20	0.70
Cross Timbers	1	3.50
	10	1.77
	20	1.45
Cross Timbers (Granitic Soils)	1	2.80
	10	1.35
	20	1.10
Grand Prairies	1	0.90
	10	0.67
	20	0.61
Texas Blackland Prairie	1	2.52
	10	1.60
	20	1.35
Cherokee Prairies	1	0.90
	10	0.59
	20	0.47
Ouachita Mountains (Includes Ozark Highland)	1	0.70
	10	0.41
	20	0.30
Southern Mississippi Valley Alluvium	1	0.55
	10	0.39
	20	0.35
Southern Coastal Plain	1	0.77
	10	0.49
	20	0.43
Southern Mississippi Valley Uplands	1	0.66
	10	0.40
	20	0.35

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Forest Land Problems

The loss of feasible growth and quality of merchantable production and the lack of forest conditions that generate needed benefits in soil and water management are the basic problems that affect the forest resource. Many forest landowners lack sufficient inventory and developed growth-potential for best returns in the strengthening stumpage markets of the Study Area. Poor condition of forest cover and inadequate development of forest soils on much of this acreage reduce considerably the beneficial influence of forest areas on ground water recharge and sediment reduction.

Table 38 shows commercial forest land by area-condition class. In deriving this data, desirable growing stock on the upland area was considered to be vigorous southern pines, or well-formed hardwoods of a readily merchantable species, growing on a site capable of producing a merchantable tree. Desirable growing stock on bottomland areas is well-formed, vigorous hardwoods of a species readily acceptable, or preferred, for factory use. The acreage breakdown in Table 38 indicates a general lack of desirable growing stock, and occupation of much stand space by worthless or low-value trees and competing vegetation.

Table 38 - Area of Commercial Forest Land by Area - Condition Class, Red River Basin Study Area

Area-Condition Class 1/	Thousand Acres	Percent
1	857.3	8
2	935.2	9
3	2,131.6	21
4	1,534.7	15
5	3,538.9	35
6	1,182.9	12
All Classes	10,180.6	100

Source: State Forest Survey Reports, Southern Forest Experiment Station, USFS

1/ Definitions:

Class 1 - Areas 70 percent or more stocked with desirable trees

Class 2 - Areas 40 to 70 percent stocked with desirable trees and with 30 percent or less of the area controlled by acceptable growing-stock trees, cull trees, inhibiting vegetation, slash or nonstockable conditions

Class 3 - Areas 40 to 70 percent stocked with desirable trees and with more than 30 percent of the area controlled by other trees/or conditions that, ordinarily, prevent occupancy by desirable trees

Class 4 - Areas less than 40 percent stocked with desirable trees, but 70 percent or more stocked with growing-stock trees

Class 5 - Areas less than 40 percent stocked with desirable trees, but 40 to 70 percent stocked with growing-stock trees

Class 6 - Areas less than 40 percent stocked with desirable trees and less than 40 percent stocked with growing-stock trees

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On the Study Area there is a general correlation between total forest productivity and class of ownership. (See table 39.) Management levels and the prevalence of persistent problems in forest management can be likewise correlated with ownership class. There are many exceptions, but, basinwide, this approach is justified.

Table 39 - 1962 Average Volume of Growing Stock and Sawtimber Per Acre by Ownership Class, Red River Basin Study Area

Ownership Class	Volume	
	Growing Stock	Sawtimber
	Cubic Feet/Acre	Board Feet/Acre
National Forest	874	3,611
Other Federal	665	2,451
Other Public	386	1,346
Farm	405	1,162
Forest Industry	753	3,030
Other Private	495	1,694

Source: State Forest Survey Reports, Southern Forest Experiment Station, USFS

Generally, National Forest System Lands, other Federal forest lands, and state-owned land receive high-level management for all applicable forest uses (see exhibit 24). Watershed values are well-protected. Forest conditions and productivity on these lands are being brought up to the requirements of the various management plans. A 14,500-acre weapon range area of the Army Training Command in Louisiana is an exception.

Game management takes precedence on much of the state forest lands, designated game refuges, and public hunting areas. The continued use of some of these areas by free-ranging livestock, particularly hogs, is a problem in management. This problem also occurs on the Bodcau Reservoir area, a USAE holding. Use of these areas by livestock damages forest soils and desirable young growing stock, and reduces the game-carrying capacity of the areas.

Forest industry in 1962 held approximately one-quarter of commercial forest land on the Study Area. Generally, forest management is being intensified. Optimum wood production is planned for most of this area. Implementation of management plans is well-advanced.

Short rotations, as in operations restricted to pulpwood production, expose the humus in the forest soils to oxidation at relatively short intervals and limit the development of forest soils. The increasing reliance in forest industry on planting for rapid stand regeneration promises to

minimize the effects of such site exposure. The establishment of the pine plywood industry in the Study Area and the increasing integration of manufacturing operations will probably lead to sawlog rotations on much of the pine land.

The forest land ownerships in primarily agricultural operations are the most numerous, and, as an ownership class, practice the poorest forest management. The forest land acreage involved in a single farm ownership is often too little for economic operation in sustained commercial production, or the operator feels that he cannot afford the initial costs involved in reaching a high level of productivity, or the available markets hold too little promise.

Frequently, poor forest management is the result of poor management in other phases of farm operation. Insufficient forage due to poor pasture maintenance, or overstocking, leads to overgrazing of forested areas, or attempts to convert areas of commercial forest land to rangeland. The practice of burning field crop residues often brings about the frequent burning of adjacent forest areas. The pressure of operating costs in other areas of farm operation leads to sales that remove all merchantable inventory regardless of size, age, and current rate of growth. In many such operations, merchantable material of little value as growing stock is left to accumulate in the timber stands.

There are many farm operators who maintain their forest land in good condition for timber production. Most of these owners also are aware of the value of well-stocked, adequately protected forest land in game production and in soil and water management. However, most of the farm forest land acreage needs intensive land treatment, improved protection, and additional technical supervision to produce its highest return.

Data from the State Forest Surveys show the average condition of farm forest lands and other privately-owned nonforest industry lands to be very similar. There is, however, considerable difference in the acreage involved in the two classes of ownership, and in the potential contribution of each to the total forest-based goods and services available in the Study Area. Nonfarm private forest lands, not integrated with forest industry, were 50 percent of the commercial forest area in 1962.

Professional forestry assistance is not regularly employed on much of this ownership area. Management decisions are made by nonprofessional personnel in many cases. Average stocking is much less than that desirable for good forest management. Cutting and harvesting operations are largely unregulated. Average inventories are much too low to realize the growth-interest potential of these forest lands. A substantial part of this land ownership is too heavily grazed for best forest management.

The protection of forest lands from wildfire, and insects and disease that attack valuable timber species, is of basic and continuing

An active gulley area on old agricultural lands. (U. S. Forest Service Photo)

Damage from wildfire in a slash pine plantation. (U. S. Forest Service Photo)

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importance to the forest resource. Protection from such insects and diseases is especially important in that such threats may readily endanger any and all forest operations.

On forest areas whose owners desire development for recreation or hunting, the lack of suitable forest or habitat quality is a problem. Such conditions are being corrected on most public-owned areas designated for these uses. The problem remains for most private owners interested in economic returns in recreation development or game management.

Progress in Treating Problems

Cropland and Pastureland

Conservation practices have been designed to prevent further deterioration of the land resource and to reduce limitations in use. The scope and intensity of the practices increase as the use limitations of the land resource increase. Common conservation practices for cropland and pastureland include terracing, contour farming, strip cropping, water diversions, proper use of crop residues, definite cropping systems, addition of plant nutrients, grass waterways or outlets, farm drainage and water disposal, land grading, leveling or smoothing, chiseling or subsoiling, proper cultivated row direction, land bedding, liming, pasture and hayland establishment and management, provisions for livestock water, and pasture and hayland renovation. Major land use conversion sometimes is required.

The combined efforts of Federal, State, and local agricultural organizations and of landowners and operators have played a major role in treating land resource problems. It is estimated that conservation treatment, consisting of land use conversions and the common soil and water conservation practices, has been applied to about one-fourth of the Study Area.

Forest Land

A variety of programs that offer some assistance in forest land management are in effect on the Study Area. These programs are essentially aimed at improving management on private lands. The cooperative forest fire control provided by the states of Arkansas, Louisiana, Oklahoma, and Texas protects State and private lands. The 1962 status of this program on the Study Area is shown in Table 40.

Table 40- Status of Forest Fire Protection by States, Red River Basin Study Area, 1962

State	Protection Status					Average Annual Loss	
	Needing Protection	Protected	Without Protection	Federal 1/ Protection	State 2/ Protection	Protection Goal	1958-62 Results
	thousands of acres					Percent of Protected area	
Arkansas	2,022.2	2,022.2	-	105.8	1,916.4 3/	0.5	0.37
Louisiana	3,513.9	3,513.9	-	280.7	3,233.2 4/	0.25	0.31
Oklahoma							
Intensive	2,828.2	2,132.6	695.6	135.6	1,997.0	0.5	1.7
Extensive 5/	367.1	-	367.1	-	-	-	-
Texas							
Intensive	1,816.3	1,816.3	-	99.7	1,716.6	0.5	0.4
Extensive 6/	423.2	423.2	-	-	423.2	1.0	1.0

1/ Federal lands
2/ Protection by state under state-Federal cooperative program
3/ Includes 1.1 M acres of Federal land in Bodcau Reservoir
4/ Includes 35.9 M acres of Federal land in Bodcau Reservoir
5/ In post oak-blackjack oak forest type
6/ In post oak forest type

Other programs regularly provided by the States, in cooperation with the Forest Service, accomplish the following: (1) Provide planting stock at moderate prices for private and nonFederal public lands. (2) Provide tree planting service with cost-sharing on some private lands with technical assistance at no cost to private landowners. Tree planting costs are shared on nonFederal public lands. (3) Provide management assistance on private lands. (4) Develops and conducts cooperative programs for the control of forest pests, with cost-sharing on State and private lands.

Forestry programs administered by the USFS and regularly available to landowners offer the following services: (1) specialized technical assistance in management on private and public lands, (2) advice in processing forest products, (3) special information and assistance in such programs as Rural Area Development, and (4) assistance in the management of naval stores, through the Agricultural Stabilization and Conservation Service.

Other Federally-sponsored provisions for assistance in forest management are the ACP practices, tree planting, and timber stand improvement administered by Agricultural Stabilization and Conservation Service, the FHA and Federal Land Bank's long-term loans for forestry purposes, and assistance by the Soil Conservation Service in developing conservation plans and providing other assistance on forest land acreage.

Additional forest mangement assistance is available through the state forestry agencies, the Agricultural Extension Service and through the guidance and facilities of Soil Conservation Districts. Assistance in forest management is also available through representatives of the larger forest industries. Educational programs by state forestry associations also have been helpful in advancing good forest management.

All the foregoing programs and available assistance have been utilized by private forest landowners in the Study Area. (See exhibits 25 and 26 for summaries of measures installed on private and National Forest System lands.)

Some progress has been made in meeting the existing demand for forest-oriented recreation. (See exhibits 27 and 28 for development on National Forest System lands.) State planning bodies, SCD's, and responsible Federal agencies have inventoried available facilities and studied forest recreation demand (with other recreation demand). Private forest land ownership has shown increased interest in supplying public recreation demand related to forest areas to add income from forest lands.

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EXISTING DEVELOPMENT AND FUTURE NEEDS FOR WATER AND RELATED LAND RESOURCES

Existing development and future needs for water and related land resources development were analyzed by time periods. Development is proceeding throughout the Study Area and the status of development is changing continuously. For purpose of this study, existing development describes the status of water and related land resources development December 31, 1962. Future needs for development were analyzed for the next 10-15 year period, ending in 1980, and for the period from 1980 to 2080.

EXISTING DEVELOPMENT

Existing and Authorized Watershed Projects

As of December 31, 1962, twelve Public Law 566 watershed projects, including 13 CNI Watersheds in eight tributary basins, were completed or approved for operations. Figure 11 shows locations and status of these watershed developments.

Approximately 1,316 square miles are included in these watersheds. Structural measures in the watersheds consist of 264 floodwater retarding and multiple-purpose reservoirs, about 42 miles of channel improvement and irrigation delivery systems, and recreation basic facilities in connection with a multiple-purpose reservoir. Pertinent structural data are shown in Table 41.

Multiple-Purpose Reservoir - Combining Recreation and Irrigation Water Storage

1


OKLAHOMA
ARKANSAS
LE FLORE
LATIMER
PITTSBURG
HUGHES
PUSHMATAHA
McCURTAIN
POLK
HOWARD
SEVIER
LITTLE RIVER
NEVADA
HEMPSTEAD
MILLER
BOWIE
CASS
MARION
TITUS
CAMP
UPSHUR
WOOD
HOPKINS
DELTA
LAMAR
RED RIVER
FANNIN
GRAYSON
HUNT
BRYAN
CHOCTAW
MARSHALL
JOHNSTON
MENA
Gillham Reservoir
Millwood Reservoir
Tuskahoma Reservoir
Clayton Reservoir
Pine Creek Reservoir
Hugo Reservoir
Kulli Pond Lake
Big Pine Reservoir
Pat Mayse Reservoir
Lake Crook
Lake Fannin
Coffee Mill Lake
Crockett
PARIS
HUGO
Antlers
Atoka
DURANT
DENISON
SHERMAN
BONHAM
GREENVILLE
SULPHUR SPRINGS
Clarksville
Talco
Cooper
3-36
3L-8
3L-13
3-27
3-23a
3h1-6
3h1-5
3h1-4
3h2-5

VICINITY MAP

LEGEND

- County Boundary
- State Boundary
- Existing Lakes as of Dec. 31, 1962
- Reservoirs Authorized as of Dec. 31, 1962
- Comprehensive Study Area Outside The River Basin Boundary
- Basin Boundary
- 3-68 Watershed Boundary and CNI Number
- P.L. 566 Watershed Projects Completed or Under Construction
- P.L. 566 Watershed Projects Approved for Operations
- Navigation Projects Under Construction or Completed
- Navigation Projects Authorized
- Levee Under Construction or Completed
- Levee Authorized
- Channel Improvement Under Construction or Completed
- Channel Improvement Authorized

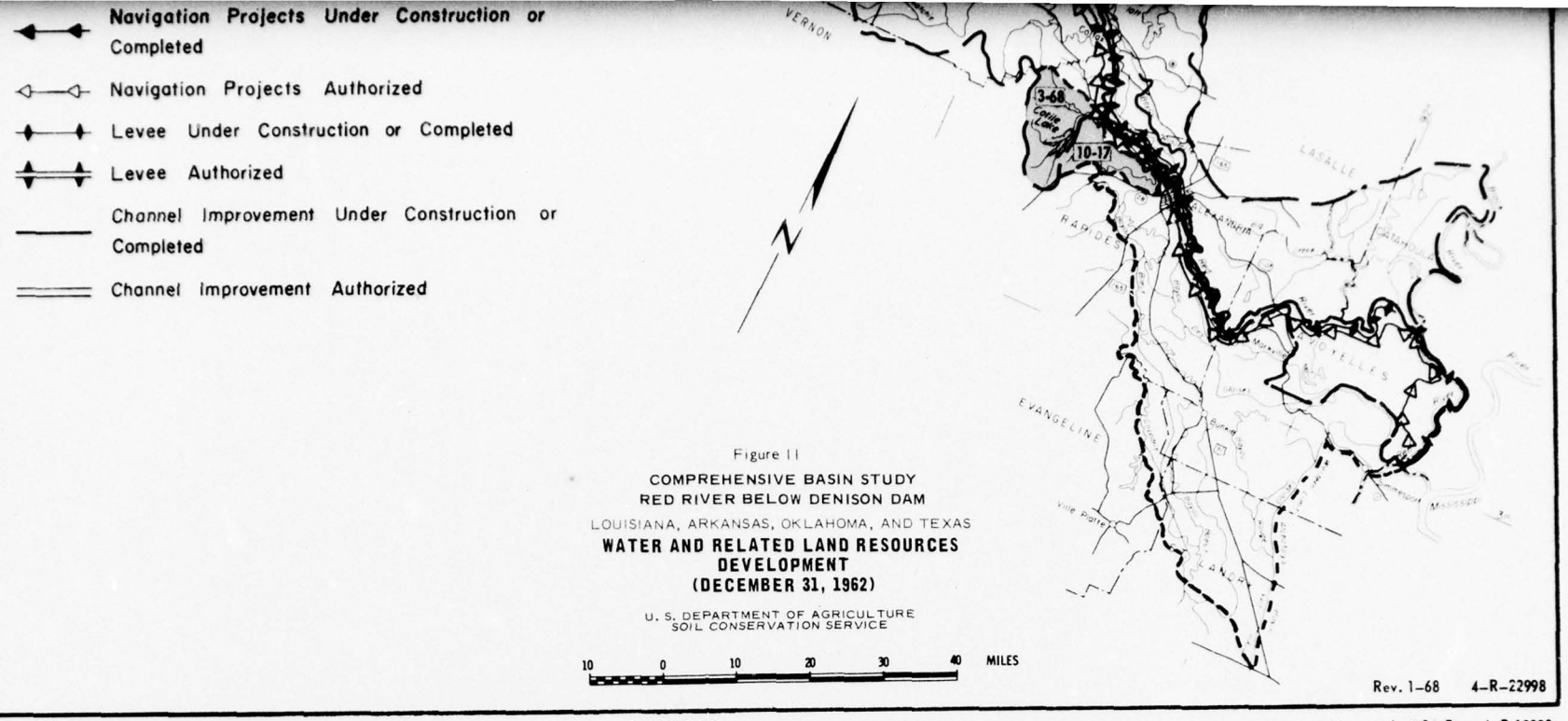

Figure 11

COMPREHENSIVE BASIN STUDY
RED RIVER BELOW DENISON DAM
LOUISIANA, ARKANSAS, OKLAHOMA, AND TEXAS
WATER AND RELATED LAND RESOURCES DEVELOPMENT (DECEMBER 31, 1962)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

OKLAHOMA PORTION COMPILED FROM USGS 1:500,000 BASE - REMAINDER FROM AMS 1:250,000 SHEETS.

EXISTING LAKES FROM ABOVE SOURCES SUPPLEMENTED WITH USGS QUADRANGLES AND COUNTY HIGHWAY MAPS

USDA-SCS-FORT WORTH, TEX. 1968

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Table 41 - Pertinent Structural Data - P. L. 566 Watershed Projects Authorized for Construction Prior to December 31, 1962, Red River Basin Study Area

Tributary Basin and CNI Watershed	Watershed Area	Drainage Area Controlled	Floodwater Retarding Structures	Channel Improvements 1/	Storage: Detention	Storage: Sediment	Storage: Other 2/	Surface Area Permanent Pool 3/
	(sq. mi.)	(sq. mi.)	number	miles	- - - (ac. ft.) - - -			acres
Intervening Areas - Texas								
3-21	73.1	40.7	15	-	14,324	2,863	-	482
Total	73.1	40.7	15	-	14,324	2,863	-	482
Intervening Areas - Arkansas & Oklahoma								
3-36	46.2	23.6	9	4.5FP& 15.0 MP	8,474	790	-	191
Total	46.2	23.6	9	19.5	8,474	790	-	191
Blue River								
3-23a	317.3	219.3	74	-	57,929	7,236	-	1,517
Total	317.3	219.3	74	-	57,929	7,236	-	1,517
Boggy Creek								
3h1-4	78.2	51.9	14	-	13,907	1,996	-	14
3h1-5	168.7	117.0	43	-	34,726	3,905	-	891
3h1-6	253.8	178.2	54	-	54,328	5,611	-	1,065
3h2-5	36.9	29.7	3	-	10,441	1,061	3,000M	535
Total	537.6	376.8	114	-	113,402	12,573	3,000M	2,505
Sulphur River								
3k-8	39.1	16.9	12	-	5,214	662	1,118M	340
3k-13	49.5	19.0	14	-	6,233	1,119	-	290
Total	88.6	35.9	26	-	11,447	1,781	1,118M	630
Loggy Bayou								
3m2-4	8.7	4.5	3	-	1,779	1,534	710M 595FW	249
Total	8.7	4.5	3	-	1,779	1,534	1,305	249
Bayou Pierre								
3n-3	90.0	44.3	22	2.9FP	14,406	2,153	-	547
Total	90.0	44.3	22	2.9	14,406	2,153	-	547
Bayou Rapides								
3-68 & 10-17	154.5	-	1	20.0ID	-	652	18,573I 5,775R	1,775 4/
Total	154.5	-	1	20.0	-	652	24,348	1,775
Grand Total	1,316.0	745.1	264	42.4	221,761	29,582	29,771	7,896

1/ Abbreviations: FP-Flood Prevention; MP-Multiple-purpose; ID-Irrigation delivery system

2/ Abbreviations: M-Municipal; FW-Fish & Wildlife; I-Irrigation; R-Recreation

3/ Total surface area at principal spillway elevation

4/ Supplemental workplan data included

Average annual benefits from these structural measures amount to $1,817,250 annually. Reduction of damages amounting to $1,043,120 comprises the major benefit item. The installation of floodwater retarding and multiple-purpose structures with capacity for sediment storage reduces the amount of sediment delivered to downstream reservoirs. In the four watershed projects in Boggy Creek Tributary Basin, annual benefits of

$7,725 will result from downstream reservoir sediment damage reduction. Additional damage reduction benefits from land treatment are estimated at $90,540. Benefits of $221,770 annually are expected from more intensive use of the floodplain. Benefits, including $20,800 from drainage, $259,630 from irrigation, $45,590 from municipal water supply, $119,810 from recreation, and $106,530 from secondary sources are summarized by CNI watersheds in Table 42.

Table 42 - Summary of Annual Benefits - P. L. 566 Watershed Projects Authorized for Construction Prior to December 31, 1962, Red River Basin Study Area 1/

Tributary Basin and CNI Watershed	Flood Prevention: Damage Reduction: Land Treatment	Flood Prevention: Damage Reduction: Structural Measures	Flood Prevention: More Intensive Land Use	Flood Prevention: Reservoir Sediment Reduction	Agricultural Water Management: Drainage	Agricultural Water Management: Irrigation	Nonagricultural Water Management: Municipal Water Supply	Nonagricultural Water Management: Recreation	Secondary	Total Benefits From Structural Measures
	- - - - - - - - - - - - dollars - - - - - - - - - -									
Intervening Areas - Texas										
3-21	3,240	49,120*	1,130	-	-	-	-	-	-	50,250
Total	3,240	49,120	1,130	-	-	-	-	-	-	50,250
Intervening Areas - Arkansas & Oklahoma										
3-36	8,660	148,240*	55,730	-	20,800	-	-	-	27,970	252,740
Total	8,660	148,240	55,730	-	20,800	-	-	-	27,970	252,740
Blue River										
3-23a	16,580	225,140*	27,210	-	-	-	-	-	25,650	278,000
Total	16,580	225,140	27,210	-	-	-	-	-	25,650	278,000
Boggy Creek										
3h1-4	2,180	40,490*	17,090	1,350	-	-	26,460	-	-	85,390
3h1-5	8,690	185,130*	56,260	2,340	-	-	-	-	-	243,730
3h1-6	24,410	233,510*	36,220	3,000	-	-	-	-	-	272,730
3h2-5	610	10,215*	-	1,035	-	-	14,360	8,080	3,780	37,470 3/
Total	35,890	469,345	109,570	7,725	-	-	40,820	8,080	3,780	639,320
Sulphur River										
3k-8	4,250	34,660	-	-	-	-	1,770	-	3,180	39,610
3k-12	8,580	35,390	830	-	-	-	-	-	2,950	39,170
Total	12,830	70,050	830	-	-	-	1,770	-	6,130	78,780
Loggy Bayou										
3m2-4	6,300	24,150	-	-	-	-	3,000	-	-	27,150
Total	6,300	24,150	-	-	-	-	3,000	-	-	27,150
Bayou Pierre										
3n-3	7,040	49,350	27,300	-	-	-	-	-	7,000	83,650
Total	7,040	49,350	27,300	-	-	-	-	-	7,000	83,650
Bayou Jean de Jean & Bayou Rapides										
10-17 & 3-68	-	-	-	-	-	259,630	-	111,730	36,000	407,360
Total	-	-	-	-	-	259,630	-	111,730	36,000	407,360
Grand Total	90,540	1,035,395 2/	221,770	7,725	20,800	259,630	45,590	119,810	106,530	1,817,250

1/ Adjusted normalized prices, Water Resources Council, April 1966
2/ Red River Main Stem benefits aggregating approximately $13,600 annually from watersheds with asterisks (*) not included
3/ Supplemental work plan data included

Red River main stem benefits above Fulton, Arkansas, estimated at $13,600 also will accrue from structural measures.

Construction costs of floodwater retarding, multiple-purpose structures, and channel improvement are estimated at $11,361,170. Costs of recreation basic facilities, installation services, administration of contracts, land, easements, and rights-of-way bring the total installation cost of structural measures to $17,347,785. These are summarized in Table 43.

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Table 43 - Estimated Structural Installation Costs - P. L. 566 Watershed Projects Authorized for Construction Prior to December 31, 1962, Red River Basin Study Area

Tributary Basin and CNI Watershed	Construction: Floodwater Retarding Structures	Construction: Multiple-Purpose Structures	Construction: Channel Improvements	Construction: Subtotal	Recreation Basic Facilities	Installation Services	Land Easements and Rights of Way	Administration of Contracts	Total	Price Base
				dollars						
Intervening Areas - Texas										
3-21	685,630	-	-	685,630	-	217,235	147,065	7,500	1,057,430	1958
Total	685,630	-	-	685,630	-	217,235	147,065	7,500	1,057,430	
Intervening Areas - Arkansas & Oklahoma										
3-36	264,760	-	144,670	409,430	-	131,020	112,560	4,370	657,380	1961
Total	264,760	-	144,670	409,430	-	131,020	112,560	4,370	657,380	
Blue River										
3-23a	2,753,455	-	-	2,753,455	-	718,195	440,890	22,200	3,934,740	1961
Total	2,753,455	-	-	2,753,455	-	718,195	440,890	22,200	3,934,740	
Boggy Creek										
3h1-4	871,245	-	-	871,245	-	222,100	81,270	4,200	1,178,815	1961
3h1-5	913,750	-	-	913,750	-	242,600	244,335	12,900	1,413,585	1959
3h1-6	1,688,635	-	-	1,688,635	-	527,605	205,360	16,200	2,437,800	1958
3h2-5	64,600	385,100	-	449,700	-	116,000	104,500	4,000	674,200	1964 1/
Total	3,538,230	385,100	-	3,923,330	-	1,108,305	635,465	37,300	5,704,400	
Sulphur River										
3k-8	289,680	-	-	289,680	-	96,175	71,530	6,000	463,385	1957
3k-13	326,955	-	-	326,955	-	104,625	49,990	7,000	488,570	1957
Total	616,635	-	-	616,635	-	200,800	121,520	13,000	951,955	
Loggy Bayou										
3m2-4	53,040	266,735	-	319,775	-	100,255	41,825	1,500	463,355	1957
Total	53,040	266,735	-	319,775	-	100,255	41,825	1,500	463,355	
Bayou Pierre										
3n-3	872,040	-	72,875	944,915	-	171,780	157,560	133,060	1,407,315	1954
Total	872,040	-	72,875	944,915	-	171,780	157,560	133,060	1,407,315	
Bayou Jean de Jean & Bayou Rapides										
10-17 & 3-68	-	1,549,600	158,400	1,708,000	284,480	651,880	494,850	32,000	3,171,210	1964 1/
Total	-	1,549,600	158,400	1,708,000	284,480	651,880	494,850	32,000	3,171,210	
Grand Total	8,783,790	2,201,435	375,945	11,361,170	284,480	3,299,470	2,151,735	250,930	17,347,785	

1/ Supplemental Work Plan data included

The amortized annual equivalent of structural measures amounts to $635,000. With inclusion of $69,075 for operation and maintenance, the total annual cost of these measures is estimated at $704,075. In comparison of these costs to average annual benefits of $1,817,250, approximately $2.60 in benefits is returned for each dollar spent on improvements. The comparison of average annual benefits and costs for structural measures is summarized in Table 44.

Land Treatment

Soil and water conservation districts have been assisting landowners in the application of basic conservation programs on farms within the watersheds for many years. Emphasis is placed on establishment of land treatment measures that will have a measurable effect on reduction of floodwater and sediment damages and costs of providing sediment storage in floodwater retarding structures. These include measures that are required primarily for establishment of good vegetative cover and improvement of hydrologic soil conditions. Cropland treatment measures include rotation hay and pasture, cover cropping in conservation crop rotations, and improved tillage to attain crop residue utilization for soil protection and conditioning. Pasture and rangeland treatment measures include planting and range seeding to establish good cover, proper use of pasture and range to maintain good cover, and construction of farm ponds to provide strategically located watering places as an aid in pasture and range management.

Approximately 100,000 farm ponds have been constructed through 1962, an average of 3.4 ponds per square mile. These ponds represent a total surface area of approximately 50,000 acres assuming a surface area of one-half acre per pond. They will hold approximately 200,000 acre-feet of water based on an average capacity of two acre-feet per pond.

Table 44 - Average Annual Benefits and Costs for Structural Measures - P. L. 566 Watershed Projects Authorized for Construction Prior to December 31, 1962, Red River Basin Study Area

Tributary Basin and CNI Watershed	Amortized Installation Cost 1/	Operation and Maintenance Costs 2/	Total Annual Costs	Benefits 3/	Benefit Cost Ratio
	- - - - - - - -	- dollars -	- - -		
Intervening Areas - Texas					
3-21	37,283	4,003	41,286	50,250	1.2:1
Total	37,283	4,003	41,286	50,250	1.2:1
Intervening Areas - Arkansas & Oklahoma					
3-36	23,978	7,867	31,845	252,740	7.9:1
Total	23,978	7,867	31,845	252,740	7.9:1
Blue River					
3-23a	142,197	6,923	149,120	278,000	1.9:1
Total	142,197	6,923	149,120	278,000	1.9:1
Boggy Creek					
3h1-4	42,601	1,290	43,891	85,390	1.9:1
3h1-5	49,843	4,220	54,063	243,730	4.5:1
3h1-6	85,957	5,580	91,537	272,730	3.0:1
3h2-5	26,826	475	27,301	37,470	1.4:1 4/
Total	205,227	11,565	216,792	639,320	2.9:1
Sulphur River					
3k-8	16,338	1,96	18,305	39,610	2.2:1
3k-13	17,226	1,497	18,723	39,170	2.1:1
Total	33,564	3,464	37,028	78,780	2.1:1
Loggy Bayou					
3m2-4	14,878	750	15,628	27,150	1.7:1
Total	14,878	750	15,628	27,150	1.7:1
Bayou Pierre					
3n-3	51,673	2,503	54,176	83,650	1.5:1
Total	51,673	2,503	54,176	83,650	1.5:1
Bayou Jean de Jean & Bayou Rapides					
10-17 & 3-68	126,200	32,000	158,200	407,360	2.6:1 4/
Total	126,200	32,000	158,200	407,360	2.6:1
Grand Total	635,000	69,075	704,075	1,817,250	2.6:1

1/ Amortized for 50 years at 2.5 percent (except for CNI Watershed 3h2-5 which was amortized for 50 years at 3-1/8 percent)

2/ Long-term prices projected by ARS, 1957 (except CNI Watershed 3k-13 which used long-term prices as projected by ARS, 1956)

3/ Adjusted normalized prices, Water Resources Council, April 1966

4/ Supplemental Work Plan data included

Table 45 shows the accomplishments from 1962 to June 30, 1966, in forest land treatment with going programs, on private lands. Recommendations for accelerated treatment of forest land were included in nine P. L. 566 watershed projects authorized (by June 30, 1966) in the Study Area.

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Table 45 - Land Treatment Accomplished on Private Forest Lands With Going Programs, Since 1962, Red River Basin Study Area

Measures	Total Installed 6/30/63 1/ to 6/30/66
	acres
Field Planting	22,300
Interplanting	4,600
Underplanting (with release)	1,400
Timber Stand Improvement	62,000
Total	90,300

1/ Data period starts after closure of records for fall-winter tree planting season of 1962-63

Land treatment accomplishments from 1962 to June 30, 1966 are shown in Table 46.

Table 46 - 1962 to June 30, 1966, Accomplishments in Forest Land Treatment on P. L. 566 Watershed Projects, Red River Basin Study Area

Purpose and Measures	Unit	Total Installed
WATERSHED PROTECTION		
Openland Tree Planting	Acres	1,130
Interplanting	Acres	2,410
Underplanting	Acres	522
Hydrologic Stand Improvement 1/		
Release of Desirable Species 2/	Acres	6,563
Grazing Control	Acres	5,710
Selective Harvest		
Thinning	Acres	4,810
Regeneration	Acres	100
FLOOD PREVENTION		
Critical Area Stabilization		
Site Preparation	Acres	99
Tree Planting	Acres	17
Roadside Erosion Control	Acres	960 3/
Intensified Fire Protection		
Equipment	No.	2 4/
Tool Caches	No.	2
Firebreaks	Miles	24

1/ To improve the hydrologic performance of forest soils and cover
2/ That build soil humus at a relatively rapid rate
3/ Applied to National Forest lands
4/ Small truck - pumper units

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Watershed management is integrated with all other phases of land management on National Forest System Lands. These lands are administratively divided into natural watershed units and these units are treated, unit by unit, to meet the outstanding watershed protection and flood prevention needs. The protection needs of watershed management units are considered in all planned use of these areas. National Forest System Lands are shown in Figure 12.

As of June 30, 1966, treatment of 1962 problem areas on all watershed management units of National Forest System Lands on the Study Area have been essentially completed. Some additional channel stabilization is needed for better water management, and completion of these measures is scheduled before 1980. Table 47 shows the land treatment accomplished on National Forest System Lands, from 1962 to June 30, 1966. Most of these measures are keyed directly to the maintenance of watershed values

Table 47 - 1962 to June 30, 1966, Accomplishments in Land Treatment on National Forest System Lands, Red River Basin Study Area

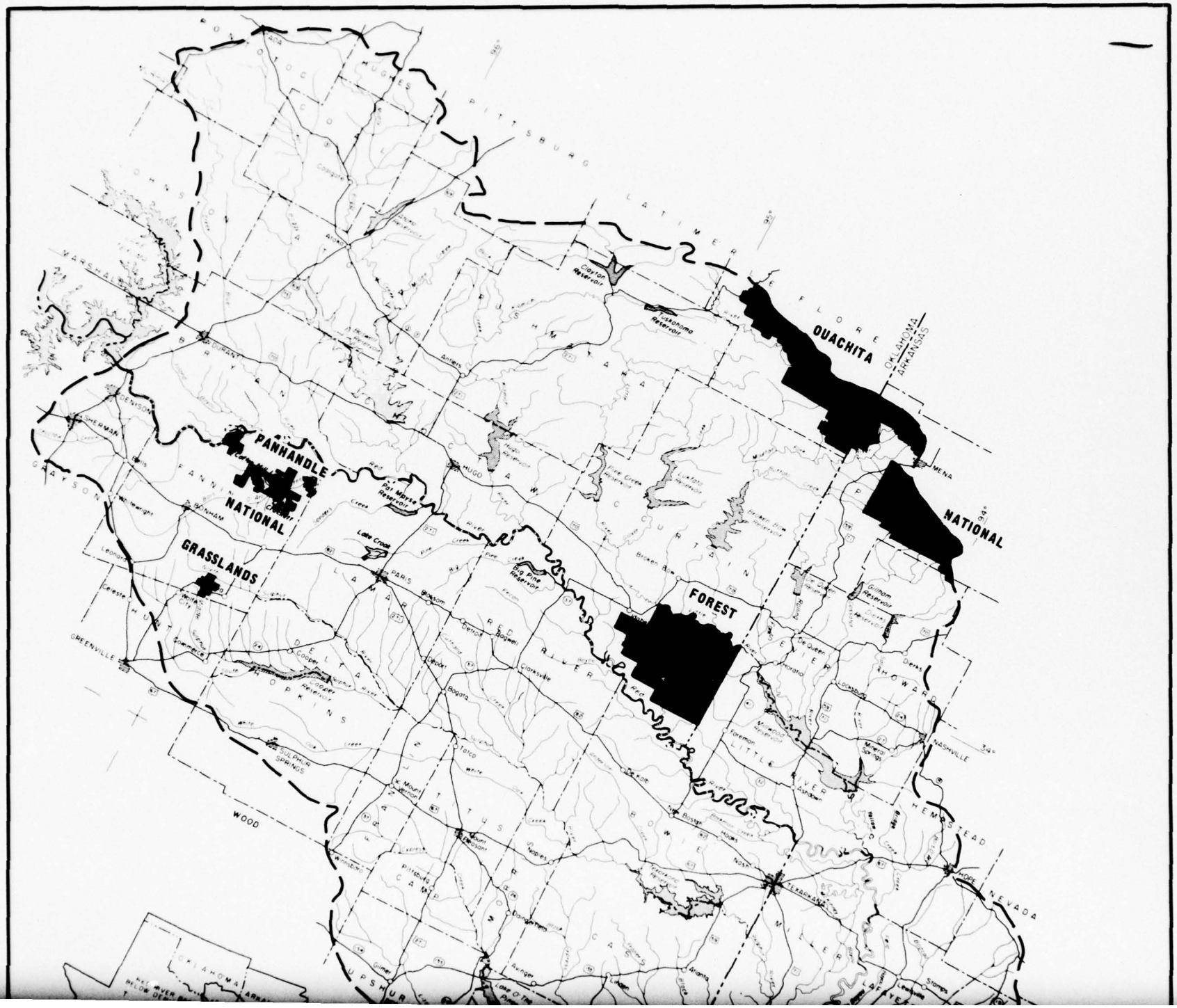
Measures	Unit	Total Installed
Tree planting	Acres	9,466
Timber stand improvement	Acres	50,236
Erosion control	Acres	1,828
Range improvement (reseeding)	Acres	170
Channel stabilization 1/	Miles	7
Total	Acres	61,700
Total (Channel Stabilization)	Miles	7

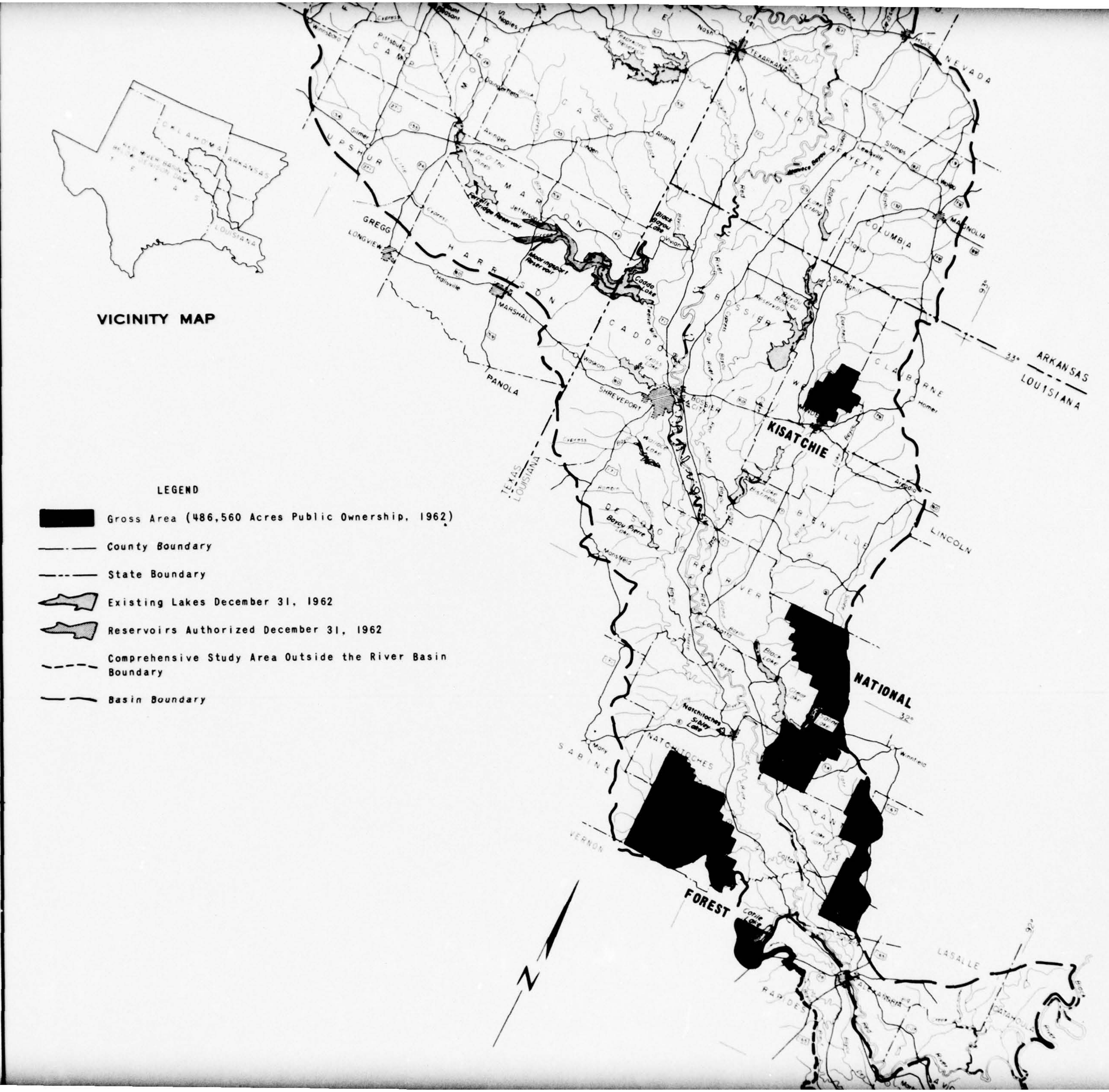
1/ Desnagging, revetment, and current control structures

Multiple-use management on National Forest System Lands has resulted in additional development of land and water areas for recreation in the Study Area. Exhibit 28 shows the 1963-67 development.

The acquisition of areas by the states for game management and public hunting has gained impetus since the study began. In the 1963-67 period, Arkansas acquired some 67,000 acres in several blocks in the Study Area. Louisiana has purchased some 71,500 acres of bottomland hardwood forest, in two blocks.

4-24879


OUACHITA
NATIONAL
FOREST
PANHANDLE
NATIONAL
GRASSLANDS
OKLAHOMA
ARKANSAS
PITTSBURG
LATIMER
LE FLORE
MARSHALL
BRYAN
JOHNSTON
PUSHMATAHA
CHOCTAW
MCCURTAIN
GRAYSON
FANNIN
LAMAR
DELTA
HOPKINS
RED RIVER
TITUS
CAMP
UPSHUR
WOOD
GREENVILLE
SULPHUR SPRINGS
PARIS
HUGO
MENA
NASHVILLE
HEMPSTEAD
NEVADA
MILLER
LAFAYETTE
HOWARD
SEVIER
LITTLE RIVER
Clayton Reservoir
Pat Mayse Reservoir
Lake Crook
Big Pine Reservoir
Gilham Reservoir
Cooper Reservoir
Lake O' The Pines


VICINITY MAP
LEGEND
Gross Area (486,560 Acres Public Ownership, 1962)
County Boundary
State Boundary
Existing Lakes December 31, 1962
Reservoirs Authorized December 31, 1962
Comprehensive Study Area Outside the River Basin Boundary
Basin Boundary
KISATCHIE
NATIONAL
FOREST
ARKANSAS
LOUISIANA
TEXAS
33°
32°
SHREVEPORT
MARSHALL
LONGVIEW
PANOLA
NEVADA
MILLER
LAFAYETTE
COLUMBIA
CLAIBORNE
LINCOLN
BIENVILLE
BOSSIER
CADDO
DE SOTO
RED RIVER
NATCHITOCHES
SABINE
VERNON
LASALLE
RAPIDES
CATAHOULA
GRANT
CASS
MARION
HARRISON
GREGG
UPSHUR
CAMP
MAGNOLIA
Caddo Lake
Black Bayou Lake
Cotile Lake

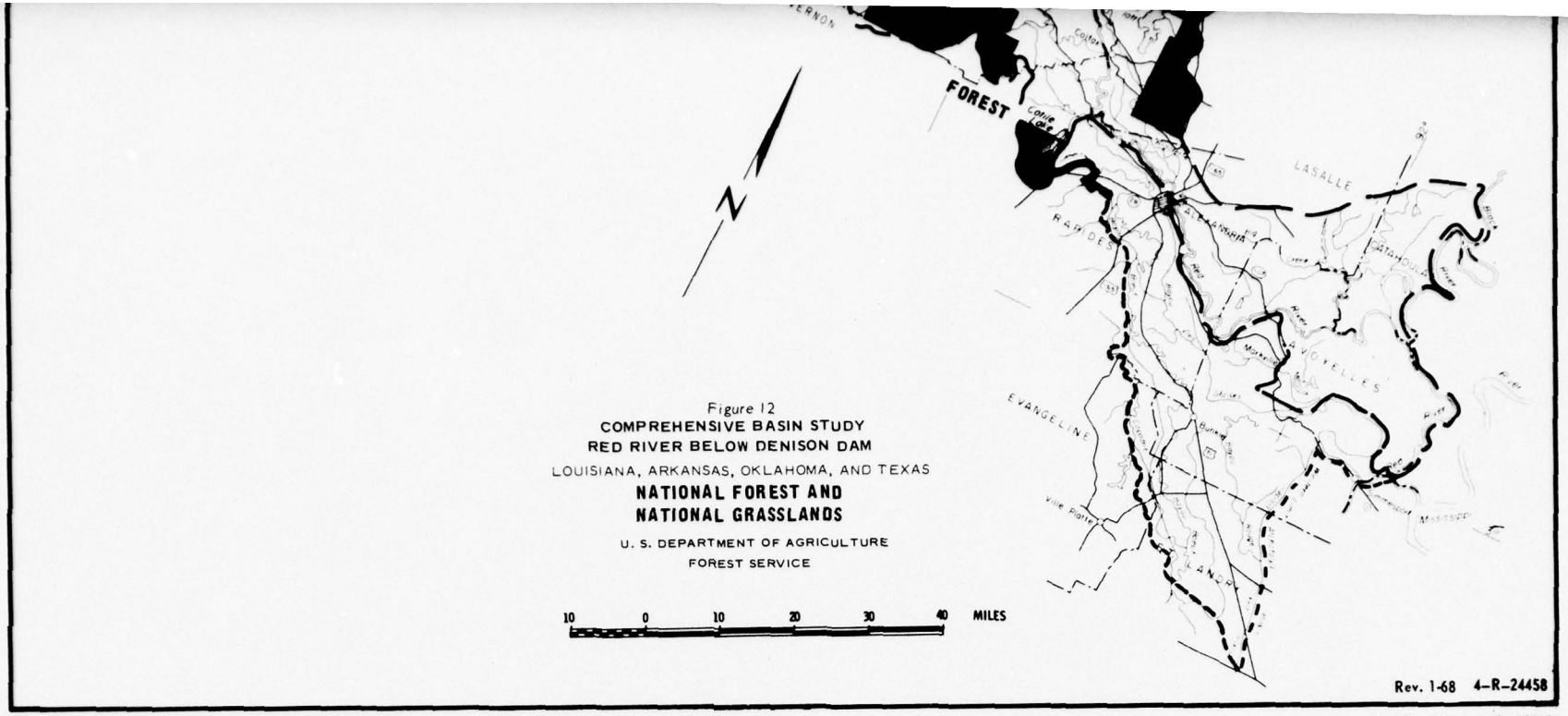


Figure 12
COMPREHENSIVE BASIN STUDY
RED RIVER BELOW DENISON DAM
LOUISIANA, ARKANSAS, OKLAHOMA, AND TEXAS
NATIONAL FOREST AND
NATIONAL GRASSLANDS
U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

Rev. 1-68 4-R-24458

OKLAHOMA PORTION COMPILED FROM USGS 1:500,000 BASE - REMAINDER FROM AMS 1:250,000 SHEETS.
EXISTING LAKES FROM ABOVE SOURCES SUPPLEMENTED WITH USGS QUADRANGLES AND COUNTY HIGHWAY MAPS.

USDA-SCS-FORT WORTH, TEX. 1968

Rev. 1-68 Base 4-R-18830

3

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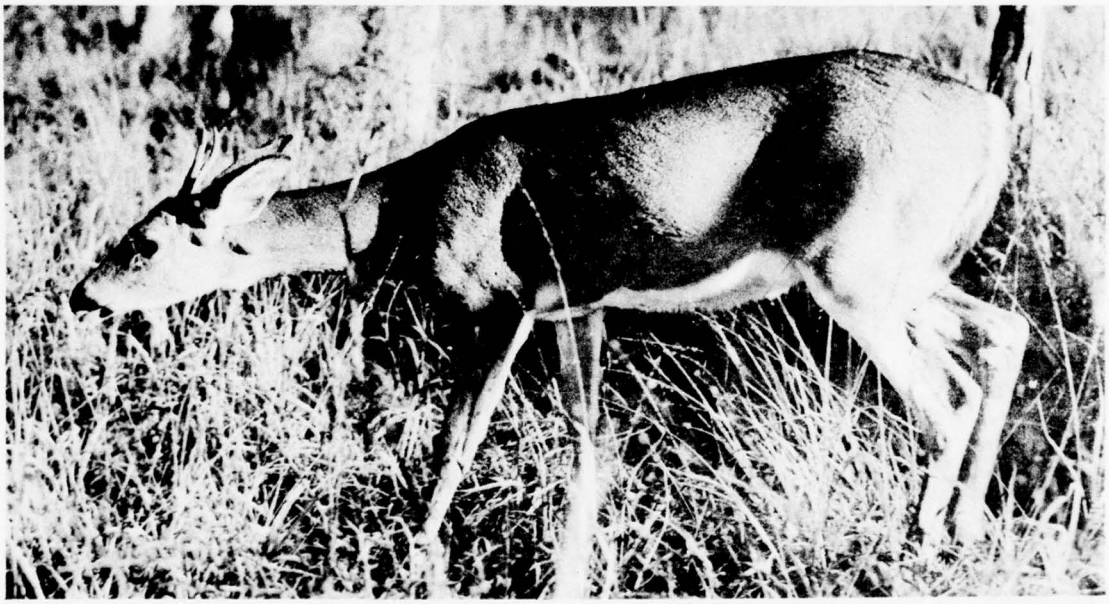
The tractor and plow of a forest fire suppression unit at work. State protection programs cover most private forest lands. (U. S. Forest Service Photo)

Erosion control on a critical sediment source on National Forest lands. (U. S. Forest Service Photo)

4-24879

Gum Springs, Winn Parish, Louisiana. A family group makes use of a recreation area on National Forestlands. (U. S. Forest Service Photo)



A Spike buck on a game management area. The deer herd on the Study Area is increasing and hunting is popular. (U. S. Forest Service Photo)

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Other Federal Water Projects

Flood control improvements often include multiple-purpose reservoirs for flood control and water conservation. Benefits from these reservoirs include the prevention of flood damages and the conservation of water for various purposes, such as municipal and industrial uses, navigation, generation of hydro-electric power, recreation, and the preservation and enhancement of fish and wildlife resources.

Under authority of the Flood Control Act of 1946 and subsequent modifications, the USAE have constructed two multiple-purpose flood control reservoirs and two single-purpose flood control reservoirs. Fifteen other multiple-purpose flood control reservoirs have been authorized for construction as of December 31, 1962 (figure 11). Since this date, construction has begun on nine of the authorized reservoirs; Hugo, Pine Creek, Lukfata, Broken Bow, DeQueen, Gillham, Dierks, Millwood, and Pat Mayse.

Complete installation of the flood control and multiple-purpose reservoirs will provide storage for 9,410,900 acre-feet of water for flood prevention and 3,055,000 acre-feet for other purposes. Rainfall runoff from approximately 19,639 square miles of drainage area will be controlled to provide reduced flood stages along Red River and pertinent tributaries. Pertinent structural data on the individual reservoirs are summarized in Table 48.

Table 48 - Existing and Authorized Reservoirs-- U. S. Army Engineers, December 31, 1962, Red River Basin Study Area

Reservoir			Storage Capacities					
Name	Status	Drainage Area	Flood Control	Municipal and Industrial	Water Quality Control	Conservation 1/	Other 2/	Surface Area 3/
		square miles	- - - - - thousand acre-feet - - - -					thousand acres
Lake Texarkana	Existing	3,400	2,509.0	0	0	145.3	0	20.3
Lake O' the Pines	Existing	850	587.2	251.1	0	3.8	0	18.7
Bayou Bodcau Lake	Existing	656	337.3	0	0	0	0	0
Wallace Lake	Existing	260	88.3	0	0	7.8	0	2.3
Caddo Lake	Existing	2,740 4/	0	0	0	0	175.0	32.7
Millwood	Authorized	4,144	1,651.4	154.6	0	52.0	0	29.2
Dierks	Authorized	113	66.0	14.0	0	0	0	1.1
Gillham	Authorized	277	164.6	0	0	33.4	0	1.4
DeQueen	Authorized	169	101.2	18.0	0	2.0	0	1.7
Broken Bow	Authorized	754	450.0	470.1	0	0	448.7	14.2
Lukfata	Authorized	291	172.0	31.0	0	4.0	0	1.0
Pine Creek	Authorized	635	378.0	70.0	0	7.0	0	16.3
Clayton	Authorized	275	104.0	0	0	186.5	0	8.9
Hugo	Authorized	1,709	809.5	0	0	40.0	0	5.5
Tuskahoma	Authorized	347	138.6	0	0	235.4	0	11.6
Boswell	Authorized	2,273	1,094.2	0	0	35.8	0	5.5
Big Pine	Authorized	95	53.6	0	0	85.0	0	4.6
Cooper	Authorized	476	131.4	240.9	0	37.0	0	9.5
Pat Mayse	Authorized	175	64.6	124.5	0	0	0	6.0
Mooringsport	Authorized	2,740	510.0	0	0	150.0	0	31.0
Totals		19,639	9,410.9	1,374.2	0	1,025.0	623.7	221.7

1/ Includes storage for sediment accumulation
2/ Caddo Lake storage is for navigation. Other storage in Broken Bow Reservoir is for hydro-electric power
3/ Water surface area exclusive of flood storage pool
4/ This area not included in total; Caddo Lake will be incorporated into Mooringsport Reservoir

The Flood Control Act of 1946 also provided the USAE authority to raise and strengthen the existing levees below Denison Dam to provide protection against a flood equivalent to that of 1945 confined by levees, and for bank protection and channel stabilization works in highly developed areas where levee relocations are impracticable. The levee system under this project consists of approximately 400 miles of levees. The bank protection works to be constructed amount to approximately 30 miles. Construction is in progress on levee and bank improvements.

Approximately 456 miles of Red River and 240 miles of tributary channel improvements have been authorized for construction by the USAE under several authorizing acts. The majority of these channels have been improved and subsequently modified.

The levee and channel improvement provides flood protection to portions of Arkansas, Louisiana, and Texas. Alleviation of flood damages to floodplain lands along Red River, and some tributaries in Arkansas, Texas, and Louisiana is provided by the projects.

The Overton-Red River Waterway was authorized in 1946 as a modification of the navigation project on Red River below Fulton, Arkansas, authorized in 1892. It provided for the construction of a navigation channel nine feet deep by 100 feet wide from the Mississippi River via Old and Red Rivers for about 31 miles, and then a new land cut generally following existing streams along the right floodplain of the Red River to a turning basin on Bayou Pierre at Shreveport, Louisiana. All work has been suspended because local interests have not agreed to provide the required local cooperation.

Cypress Bayou and Waterway between Jefferson, Texas, and Shreveport, Louisiana, was authorized in 1872 and modified in 1910. The project, completed in 1914, provided for channel improvement and construction of Caddo Lake Dam for navigational use.

In the late 1930's, the SCS constructed two reservoirs in the Land Utilization project in Fannin County, Texas. These reservoirs, Coffee Mill Lake (650 acres), and Lake Crockett (450 acres), were put under the administration of the FS in 1953.

Impoundments on National Forest System Lands serve primarily for public use in recreation and fish and game management. Floodwater storage is not usually a feature of these projects. Table 49 shows the 1962 level of development. These impoundments are maintained by the FS units involved.

Table 49 - Level of Water Development on National Forest System Lands, 1962, Red River Basin Study Area

Administrative Unit - Name	Location State and County	Drainage Area, Sq. miles	Storage Capacity Acre-feet	Surface Area, Acres	Principal Use
Kisatchie National Forest					
	Louisiana				
Caney Lake	Webster	8.0	4,100	301	Recreation
Ouachita National Forest					
	Arkansas				
Shady Lake	Polk	10.0	270	35	Recreation
	Oklahoma				
Kulli Pond Lake	McCurtain	.2	13	2	Recreation
Panhandle National Grasslands					
	Texas				
Coffee Mill Lake	Fannin	39.32	8,000	650	Recreation
Lake Crockett	Fannin	10.92	3,800	450	Recreation
Fannin Lake	Fannin	.60	344	50	Recreation

State, Municipal, and Private Water Projects

Surface water has long been recognized as a valuable source of water supply and water-based recreation. By 1962, four municipalities and one industrial firm had developed and were using approximately 309,700 acre-feet of water from surface reservoir storage.

Oklahoma City, Oklahoma, constructed Lake Atoka in Atoka County, Oklahoma, to supplement municipal water supplies. The water is delivered to the city through 125 miles of pipeline. The City of Paris, Texas, constructed Lake Crook for municipal water storage. Sibley Lake was constructed by Natchitoches, Louisiana, to supplement ground water supplies that were inadequate to serve municipal expansion in recent years. Cross Lake was constructed by the City of Shreveport, Louisiana, to replace Red River as a source of municipal water. Industrial water requirements prompted the International Paper Company to construct Lake Erling on Bayou Bodcau in southern Arkansas. Although recreation was not a primary purpose in many of these reservoirs, facilities have been added for swimming, boating, and camping. Facilities for fishing, skiing, and other water sports generally are provided. Figure 11 shows the location of these reservoirs.

Black-Clear Lake, Saline Lake, Lake Bistineau, Bayou Pierre, Kepler, Iatt, and Black Bayou Lakes were developed by the Louisiana Department of Public Works for recreation use. Approximately 84 square miles of water surface are available on these lakes. The primary purpose for construction of these reservoirs was for fishing and hunting; however, other facilities such as boating, camping, and swimming have been added in some areas. Lake Bistineau State Park is one of the areas that provides facilities for most water-based recreational uses.

These projects include 650,650 acre-feet of storage. Table 50 summarizes pertinent reservoir data and purposes.

Table 50 - Existing State, Municipal, and Private Reservoirs, December 31, 1962, Red River Basin Study Area

Reservoir	State	Storage Volume	Surface Area	Purpose 1/
		acre-feet	square miles	
Cross Lake	La.	76,700	14.0	M
Sibley Lake	La.	19,500	3.4	M
Lake Erling	La.	77,000	10.9	I
Black-Clear Lake	La.	109,000	21.6	R
Saline Lake	La.	52,000	13.0	R
Lake Bistineau	La.	120,400	26.9	R
Bayou Pierre	La.	11,500	4.6	R
Kepler Lake	La.	16,800	3.0	R
Iatt Lake	La.	13,500	8.4	R
Black Bayou Lake	La.	17,750	6.2	R
Atoka Lake	Okla.	125,000	9.2	M
Lake Crook	Texas	11,500	2.0	M
Total	--	650,650	123.2	-

1/ Abbreviations: M--municipal water supply; I--industrial water supply; R--recreational uses

FUTURE DEVELOPMENT NEEDS

Area Redevelopment

Overall Economic Development Programs have been developed for counties or parishes in each of the four states included in the Study Area. The primary purpose of the programs for various counties was to analyze economic conditions, especially in the rural sector, and to devise ways to help meet the needs of the areas. The following counties are eligible for assistance under the Area Redevelopment Act: Columbia, Hempstead, Lafayette, Little River, Nevada, Polk, and Sevier Counties in Arkansas; Avoyelles, Catahoula, Evangeline, Natchitoches, Red River, Sabine, and Vernon Parishes in Louisiana; Atoka, Choctaw, Coal, Hughes, Latimer, LeFlore, McCurtain, Pittsburg, Pontotoc, and Pushmataha Counties in Oklahoma; and Delta, Fannin, Marion, and Red River Counties in Texas.

The primary objective of the Economic Development Program is to insure employment opportunities, sustain purchasing power, and maintain an adequate tax structure in an area. To attract new industries into an area, adequate water is required to supply municipal and industrial needs. Sources of credit for adequate financing of new developments are needed. In order to maintain the rural population, income levels, and

economic standards of living must be improved. Resources must be used more nearly to their full potential in order to achieve these goals.

Crop and Pasture Land Resources

Projections of future requirements were made without consideration of productive capacity, but rather the production which must be achieved for the Study Area to maintain its relative position in the Nation's agriculture (exhibits 29 and 30). This assumed the projected share of National requirements and represents an allocation of production requirements among all areas of the United States. It also assumed that there will be no further acceleration in the rate of resource development.

This allocation provides a benchmark to which the productive capacity of the Study Area can be compared. If the productive capacity required to produce this volume exists, then it indicates the probable future level of production. It is assumed that the future competitive position of the Study Area will be relatively the same as at the present.

A summary of feed units required for feed crop requirements and projected production without project development is shown in Table 51. Although a surplus existed in the base year, deficits of 1,661 and 17,002 million feed units are projected for 1980 and 2010, respectively.

Table 51 - Feed Units Required and Feed Units Produced Without Project Development, 1962, 1980, and 2010, Red River Basin Study Area

Item	1962	1980	2010
	- - million feed units - - -		
Feed units required to produce Study Area livestock products	8,121.6	15,494.6	32,166.0
Total feed units produced without project development	11,722.0	13,833.6	15,163.3
Balance	+3,600.4	-1,661.0	-17,002.7

Adjustments of Crop and Pasture Land Utilization

Production requirements for feed-crops, including range and pasture, were expressed as a composite, measured in terms of feed units. The projected feed units that could be produced without further acceleration of the rate of resource development were compared with the projected requirements. Nonfeed crops projected requirements were expressed as an allocation of National requirements among all areas of the United States.

The maximum productive capacity of the Study Area has not been measured. Conversion of land to a more intensive use, drainage, flood

control, and irrigation are all means of increasing production from land and water resources. Resource development may be accomplished by project-type action or by individuals. Production increases may also occur as a primary effect from flood control projects.

Three alternative ways to achieve feed-unit requirements are: (1) additional feed-crop production without project development, (2) additional feed-grain production without project development, and (3) additional feed-grain production with project development.

Additional Feed-crop Production Without Project Development

In 1980 and 2010, projected feed-unit production based on historical data falls short of the projected needs. Historical data reflect internal shifts between all feed crops, and these changes are likewise reflected in the extension of trends to 1980 and 2010.

Historical distribution of feed units would suggest that the 1980 deficit of about 1.7 billion feed units be allocated among the three major feed-crop components according to their share of total production (table 52). Therefore, in 1980, 2.5 percent of the deficit would be allocated to feed-grain crops, 6.0 percent to hay crops, and 91.5 percent to grazing and pasture. Deficits for 2010 would be handled in the same manner. The allocated feed units for each major feed-crop component is divided by its weighted feed unit per acre to determine the acreage requirement.

Table 52 - Percentage Distribution and Feed Units Per Acre by Three Major Feed Components, Without Accelerated Development, 1962, 1980, and 2010, Red River Basin Study Area

	1962		1980		2010	
	Percent distribution	Weighted feed units per acre	Percent distribution	Weighted feed units per acre	Percent distribution	Weighted feed units per acre
Feed grains	3.3	1,472	2.5	1,781	2.6	2,037
Hay crops	4.3	1,196	6.0	1,422	9.6	2,271
Grazing and pasture	92.4	951	91.5	1,105	87.8	1,180
Total	100.0	971	100.0	1,131	100.0	1,252

Following this procedure, an additional 1,469,000 acres must be converted to feed-crop production in 1980. By 2010, over 12,651,000 acres will be required to meet the Study Area's requirements of the National production of feed crops.

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Additional Feed Grain Production Without Project Development

The projected feed units per acre for feed grains in 1980 and 2010 are 1,781 units and 2,037 units, respectively. A balance between projected production without project development and the Study Area's requirements may be achieved wholly by feed grains. Approximately 933,000 acres of additional land would need to be converted to feed grain production by 1980 to meet requirements, and an additional 8,347,000 acres in 2010. Since feed grains have greater capacity for feed unit production per acre, this alternative method is also suggested.

Additional Feed Grain Production With Project Development

Assuming drainage and flood control improvement projects in place by 1980 and 2010, another alternative is presented to meet a balance between land conversion and feed unit requirements. With project development in place, increased yields, and high levels of management, additional output will be realized in feed grains alone. For example, it is estimated that under these conditions, feed units per acre will increase from 1,781 units to about 2,400 units in 1980. Therefore, an additional 366,400 acres of feed grains would be required in 1980 to meet the feed unit deficit, and over 6.5 million acres in 2010.

Forest Land Resources

There was a net increase in commercial forest land of the Study Area between 1952 and 1962, but the rate of increase declined during the latter part of the decade. The principal areas of accretion were on the uplands with some increase along the floodplain areas of the smaller streams. Attrition by reservoir and highway construction and increased urbanization has blunted the trends toward increasing forest acreage on the uplands, but no rapid decrease in forest acreage can be foreseen. Apparently the acreage available for development of the forest resource will remain largely intact through 2010.

Since 1962, forest acreage along the major floodplain has sharply decreased. The future availability of any considerable acreage of forest land along the main stream and larger tributaries is questionable at present (1967).

Analysis of forest cover conditions for 1962 showed that the Study Area was producing only 40-50 percent of its potential due to inadequate stocking and competition from worthless vegetation.

The 1962 condition of forest soils on much of the Study Area is less than that desirable for good soil and water management. Improvements in fire protection are needed. Some 875,400 acres of forest land now unprotected should be placed under organized fire protection. Grazing control is needed on seven percent of the commercial forest land area. Approximately nine percent of the commercial forest area needs interplanting to improve stocking and some 26 percent of the forest stands need thinning to improve stand vigor and composition.

An estimated additional growth of 110 to 135 million cubic feet per year will be required to meet the manufacturing capacity of forest industry in and near the Study Area by the year 2010, above that which can be expected with the present level of management. With the 1962 level of management, cut is expected to exceed growth near the year 1990. To forestall undue losses in established inventory and growth potential that would begin to occur around 1990, additional new inventory would have to be built up prior to that time. This new production potential should begin to make some contribution in available wood supplies by 1985 to 1990. The maximum production should be required during the 2000 to 2010 period.

The area of private (nonforest industry) forest lands, with average volume of growing stock, were as follows:

	Volume of Growing Stock, Cubic Feet/Acre	Total Forest Land 1,000 Acres
Farm ownership	405	2,015.4
Other ownership	495	5,137.8

The average annual growth of desirable merchantable material is less than 1/2 cord, or 200 board feet, per acre. The annual growth on most of these lands could be increased two to four times with reasonably good management.

Sustained yield management, comparable to that now employed by well-established forest industry, on about 2,250,000 acres of the most productive private forest lands would meet the expected shortages for the Study Area.

There is a looming National and Regional shortage in hardwood face veneer logs and high-quality hardwood sawlogs for factory use. Projections from 1962 data, as used in this report, do not fully illustrate the supply problem that is developing in the Study Area. The lack of well-managed hardwood acres, coupled with the accelerated clearing since 1962 of the most productive remaining sites, is resulting in unexpected supply problems for manufacturers in or near the Study Area.

If this future hardwood supply shortage is to be alleviated, high-level sustained yield management will be required on all remaining bottomland hardwood areas, and all suitable upland sites must be managed for quality hardwood production.

Water Resources

Municipal and Industrial Water Supply Needs

Water supply problems, as projected through the time periods 1980, 2000, 2030, and 2080, will be ever increasing. Table 53 summarizes the municipal and industrial needs for these periods by states. From the

1980 needs of 200 mgd, requirements will practically double in each succeeding period.

Table 53 - Municipal and Industrial Water Supply Needs 1/, Red River Basin Study Area

State	1980	2000	2030	2080
	million gallons per day			
Oklahoma	1.1	3.7	13.5	155.5
Arkansas	14.3	21.0	41.9	120.6
Texas	60.3	91.9	157.3	334.7
Louisiana	124.3	263.1	364.3	804.6
Total	200.0	379.7	577.0	1,415.4

Source: FWPCA data
1/ Net requirements

Municipal expansion, resulting from population increases, will be the major factor contributing to these increases in water supply needs.

Water Quality Control Needs

As determined by FWPCA, stream pollution will increase with continued population and industrial growth. Detailed water quality control requirements to the year 2080 will be presented in Appendix XI.

Rural Household and Livestock Water Requirements

Rural households and livestock water requirements were projected for the economic evaluation period (1962 to 2010), and are summarized in Table 54. These projections are based on average daily water consumption per person, or per animal unit. Data for the 2080 time frame were computed following the assumption that water use ratios for rural households and livestock will remain constant after 2020.

Table 54 - Total Annual Water Requirements for Rural Households and Livestock Uses, 1962, Projected 1980, 2010, 2020, 2080, Red River Basin Study Area 1/

Year	Annual rural household water requirements 2/	Annual livestock water requirements	Total annual water requirements
	million gallons		
1962	22,776	12,432	35,208
1980	31,288	16,321	47,609
2010	37,254	23,044	60,298
2020	38,506	25,308	63,814
2080	38,506	25,308	63,814

1/ Whole counties are represented in the four Basin States of Arkansas, Louisiana, Oklahoma, and Texas
2/ Annual household water requirements include rural farm and rural nonfarm households

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Rural farm and rural nonfarm household water requirements are shown in Exhibit 31. Estimates were derived by multiplying the projected rural population by the average daily water consumption per person by 365 days to determine annual requirements. This resulted in a declining total annual demand for domestic water by rural farm families, and an increasing total annual demand for domestic water by rural nonfarm families. Demand is estimated to be about 31.3 billion gallons annually in 1980, and 37.3 billion gallons by the year 2010.

Livestock water requirements are projected to increase to more than 23 billion gallons on basin farms by 2010 (exhibit 32). This amount is about twice the present livestock water requirements.

Cattle and calves required over 11.5 million gallons of water in 1962. This amount represents 93 percent of the total livestock water requirements. This figure does not change significantly in its relationship to total water requirements. However, the increasing production of broilers will require a larger share of water requirements, while hogs and pigs decline in numbers and water consumption. Annual livestock water requirements represent 35 percent of the total in 1962, 34 percent in 1980, and 38 percent by 2010.

Recreation Resources

Total outdoor recreation demands were estimated for 1960, 1980, and 2020. Existing public and private outdoor recreation opportunities were inventoried.

This study includes an inventory of recreation opportunities enhanced by water which appears to be physically feasible in potential upstream watershed projects. Also, consideration is given to the active recreational use of developed resources as supplied by BOR.

The study evaluates the present types of water oriented recreation activities and the present demand and supply. Unsatisfied demand and the needs for land, water, and facilities to accommodate these anticipated demands were estimated. Activities have been grouped by subareas that indicate a general geographical distribution of these water-enhanced activities.

Demand

The total annual demand for outdoor recreation in the Study Area is increasing at a faster rate than population. Population is estimated to increase 94 percent between 1960 and 2020, while total annual demand for recreation is estimated to increase over 725 percent. Table 55 summarizes the existing and projected population and total annual recreation demand.

Recreation demand is defined "as the types and quantity of outdoor recreational activities that people desire. True demand is assumed to be that which people will accept in view of their expressed desires and wants". Closely correlated with recreation demand is per capita personal

income and activity occasions per capita. BOR criteria conclude that, for most activities, a person's rate of participation in outdoor recreation is proportional to his income. However, this is not to imply alternative criteria do not exist in recreation planning.

Table 55 - Existing and Projected Resident Population and Total Annual Recreation Demand, 1960, 1980, and 2010, Red River Basin Study Area

Year	Resident population in drainage area 1/	Total annual demand 2/
	number	activity occasions
1960	1,670,048	25,043,500
1980	2,187,000	54,127,200
2020	3,235,800	207,535,000
Projected increase:		
1960-1980:		
Net	516,952	29,083,700
Percent	31	116
1980-2020:		
Net	1,048,800	153,407,800
Percent	48	283
1960-2020:		
Net	1,565,752	182,491,500
Percent	94	727

1/ Whole county population data are presented
2/ See Table 57

The approach followed by BOR in computing demand is an acceptable method. Their demand function or input-output relationship denotes consistent or linear returns in activity occasions based on income per capita and participation in the Census South Region. The participation function (exhibit 33) reflects a constant increase in relation to population, income per capita, and recreation participation activity. These are based on 1960 data. Data developed by BOR for 1965 show only minor changes in participation rates.

Existing and projected population and per capita personal income for the four ERS subareas are presented in Table 56. Per capita personal income data for 1960 were obtained from a USDC publication. The per capita personal income for each subarea are weighted averages based on population and county income. Projected per capita personal income was obtained from BOR's "Interim Report", and population projected data were obtained from the USAE. These projected personal income data were derived by projecting historical trends into the future and adjusting to 1960 dollars. Exhibit 34 presents the counties in each subarea with population and per capita personal income for 1960.

Table 56 - Population and Per Capita Personal Income, by Subareas, 1960, 1980, and 2020, Red River Basin Study Area

Subareas:	Population			Per capita personal income 1/		
	1960	1980	2020	1960	1980	2020
	- - - - number - - -			- - - dollars - - -		
1	152,519	172,700	221,500	1,141	1,932	5,195
2	133,670	162,600	244,700	905	1,532	4,117
3	341,888	438,500	725,300	1,360	2,122	5,413
4	1,041,971	1,413,200	2,044,300	1,232	2,026	5,232
Basin Total	1,670,048	2,187,000	3,235,800	1,224	2,001	5,185

1/ 1960 dollars

Recreation facilities are subject to seasonal and daily variations in demand. Outdoor activities maintain a level during the winter hunting season and spring. The peak season starts with the close of schools, reaches its high through the summer, and drops off again in September. Table 57 presents a summary of the peak-day, or average Summer Sunday demand 1/. Also, this table shows the total annual demands for 1960, 1980, and 2020. A refinement of these data by subarea is presented in Exhibit 33.

Table 57 - Recreation Demand: Summary of Existing and Projected Total Annual, Summer and Average Sunday Demand in Activity Occasions, Red River Basin Study Area, 1960, 1980, and 2020

Activity or Activity Group	Average Summer Sunday			Total Summer (1,000)			Total Annual (1,000)		
	1960	1980	2020	1960	1980	2020	1960	1980	2020
	- - - - - - - - - - - - activity occasion - - - - - - - - - - -								
Canoeing	2,220	4,844	18,500	68.8	148.8	570.5	113.4	245.0	939.7
Boating, Sailing, & Waterskiing	42,930	92,810	355,740	1,395.2	3,015.3	11,561.3	2,768.0	5,982.5	22,938.2
Swimming	138,500	299,330	1,147,740	4,503.3	9,733.0	37,318.5	6,285.1	13,584.4	52,085.3
Subtotal	183,650	396,984	1,521,980	5,967.3	12,897.1	49,450.3	9,166.5	19,811.9	75,963.2
Camping	23,280	50,290	192,930	431.4	932.2	3,189.4	897.1	1,938.8	7,433.5
Picnicking	44,760	98,870	379,220	1,486.3	3,212.2	12,316.4	3,142.6	6,792.1	26,042.6
Subtotal	68,040	149,160	572,150	1,917.7	4,144.4	15,505.8	4,039.7	8,730.9	33,476.1
Playing Games	10,330	22,320	85,610	334.1	722.1	2,768.7	1,459.9	3,155.4	12,098.4
Fishing (Incidental)	15,390	33,220	127,490	498.1	1,076.6	4,127.9	1,200.8	2,595.2	9,950.5
Sightseeing	55,880	120,780	463,160	1,814.3	3,921.3	15,034.7	5,772.8	12,477.0	47,839.7
Hiking	5,860	12,720	48,600	192.4	415.8	1,594.1	396.8	857.8	3,288.3
Nature Walks	19,240	41,610	159,380	623.7	1,347.9	5,168.2	3,007.0	6,499.0	24,918.2
Subtotal	106,700	230,650	884,240	3,462.6	7,483.7	28,693.6	11,837.3	25,584.4	98,095.7
Total	358,390	776,794	2,978,370	11,347.6	24,525.2	93,649.7	25,043.5	54,127.2	207,535.0

Supply

Supply, as it relates to recreation, is the inventory of existing facilities which are available to satisfy demand. The known water-oriented public supply in the Study Area was inventoried by the BOR.

1/ Peak-day, as it is referred to, means the average Summer Sunday. This is the day when the greatest demand, outside of peak holiday use (July 4 or Labor Day), is put upon the facilities

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This inventory points up that the present supply of outdoor recreation land and water facilities is poorly developed, particularly the latter. The proposed reservoir construction and bank stabilization programs by USDA and other action agencies will greatly increase the water-dependent recreation supply.

In 1960, P. L. 566 projects did not supply or provide for any appreciable recreation facilities for the general public. However, State and locally constructed water-oriented facilities are widely used because of the variety of recreation they provide. In addition to fishing, many other activities, such as swimming, boating, and waterskiing are also important. Recreation facilities are not necessarily limited to water sports but may include hunting, picnicking, camping, children's playground activities, and competitive sports.

Man-day fishing allocations to the proposed multiple-purpose USDA reservoirs were computed by the BSF&W in Atlanta (exhibit 35) 1/. The data depict weighted averages depending on fishing needs for the individual states along the Red River. These allocations may change as planning by other agencies progresses and other impoundments are considered.

The recreation facilities' supply is translated to an annual supply of recreation-days. This provided a means to obtain "total recreation days" by adding the supply of recreation facilities using BOR's criteria and fishing supply developed by BSF&W.

Unsatisfied Demand and Needs

Future outdoor recreation facilities should reflect the needs of the Study Area's population and ability of the Federal, State, County, and local officials and citizens to recognize and provide for the needs. Recreation facilities in 1980 and 2020 will include the present facilities, expansion and development of these facilities during the ensuing years, and the acquisition and development of these facilities resulting from planning.

Future needs are based upon increases in both population and per capita personal income. Leisure time resulting from a shorter work week, an increase in the days of paid vacation per worker, and earlier retirement are also complementary forces.

Table 58 sets forth the criteria used to determine the unit need for recreation facilities. Studies by BOR and others in the growing field of recreation planning have determined the type of facilities needed. These needs may change with changes in the interests of people such as the increase in skin-diving and related forms of water recreation. However, to provide sufficient outdoor recreation areas at this time would not appear to be in error. Rather, it would appear preferable to have

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1 A "man-day" and "recreation-day" are assumed to be the same measurement, or a visit by one individual for recreation or fishing purposes during any portion or all of a 24-hour day.

too much rather than to fall short, since land areas available for recreation may continue to diminish.

Table 58 - Tentative Use Standards for Selected Outdoor Recreation Activities 1/

Camping:
Prepared site camping, 3 five-person sites per acre
Wilderness camping, 1 camp site per acre
Picnicking:
Prepared site picnicking, 7 five-person tables per acre with a turnover of two per table. One acre will accommodate 70 persons per day.
Wilderness picnicking, 2 five-person tables per acre with a turnover of two per table.
Boating:
6 acres of water surface per boat and 3 persons per boat with a turnover of 2
1 boat ramp per 40 boats
Swimming:
1 acre of beach and water for each 200 swimmers with a turnover of three per day. (Ratio of 2/3 acre of beach, 1/3 acre of water)
Hiking:
One-eighth mile of trail per hiker
23 acres per mile of trail
Waterskiing:
15 acres of water area per towing boat
Fishing:
10 linear feet of shore per person
Historical sites:
200 square feet per person
Nature study:
10 acres per person
Pleasure driving:
0.25 miles of scenic roadway per car

1/ U. S. Department of Interior, "Interim Report on the Demand, Supply and Needs, Red River Basin." Bureau of Outdoor Recreation, Atlanta, February 1, 1967: and Florida Board of Conservation, "Florida Land and Water Resources, Southwest Florida, 1963, 1980, and 2015". Division of Water Resources, Tallahassee, 1966.

Table 59 presents a summary of demand, supply, and unsatisfied demand for selected water-oriented recreation activities to meet total peak-day demand in 1960, 1980, and 2020. Unsatisfied demand was translated into needs expressed in types of facilities. These data represent the total need for a resident population indicated in Table 57.

Data in Table 59 substantiate the need for recreation facilities, especially when needs are expressed in activity occasions and then reduced to needed facilities. However, projected needs do not consider

substitute activities, nor do these preliminary data represent a real, or net unsatisfied demand.

Table 59 - Existing and Projected "Average Summer Sunday" Demand and Needs for Water-Orientated Recreation Facilities, with Needs Expressed in Facilities, Red River Basin Study Area

Supply and demand by time period	Boating	Swimming	Camping	Picnicking
	activity occasions			
1960				
Average Summer Sunday demand	42,930	138,500	23,280	45,760
Supply:				
Public & private	64,850	15,782	10,064	34,062
SCS 1/	-	-	-	-
Unsatisfied demand	+21,920	122,718	13,216	11,698
Needs expressed in facilities	-	205 acres	2,643 units	1,170 tables
1980				
Average Summer Sunday demand	92,810	299,330	50,290	98,870
Supply:				
Public & private 2/	64,850	23,846	18,713	51,423
1980 SCS	3,797	25,080	2,231	17,925
Unsatisfied demand	24,163	250,404	29,346	29,522
Needs expressed in facilities	48,326 acres	418 acres	5,868 units	2,952 tables
2020				
Average Summer Sunday demand	355,740	1,147,740	192,930	379,220
Supply:				
Public & private 2/	64,850	23,846	18,713	51,423
2020 SCS	3,918	78,360	7,635	45,990
Unsatisfied demand	286,972	1,045,534	166,582	281,807
Needs expressed in facilities	573,944 acres	1,743 acres	33,316 units	28,181 tables

1/ No Soil Conservation Service projects prior to December 31, 1962 with recreation facilities.
2/ Projected data for 1980 and 2020 are an enlargement of existing facilities that were reported on December 31, 1962 (Table 66). These data do not include SCS facilities.

NOTE: Projected 1980 and 2020 public supply data were not available at the time this report was prepared. Public supply is delineated by Federal, State, and local agency, including SCS projects in Appendix XII (Outdoor Recreation).

The projected supply to 1970 was computed by BOR from a nationwide inventory of programmed supply. The 1970 public supply represents an enlargement of existing facilities that were reported on December 31, 1962, or the supply that has been definitely programmed. The SCS supply for 1980 and 2020 represents the capacity that the proposed multi-purpose projects can provide. Therefore, unsatisfied demand as shown in Table 59 does not include project proposals being planned by Federal, State, or local agencies other than the SCS. However, based on available data, there will be a shortage of supply facilities in the Study Area for 1980 and 2020 for these selected activities.

By 1980, 48,300 surface acres of water will be necessary to meet the demand for boating; 418 acres of beach and water area for swimming; over 5,800 units of camp sites; and approximately 3,000 additional picnic tables.

Projected needs to 2020 point up a vast shortage of supply facilities in the Study Area for boating, or an additional 573,944 surface acres of water. Swimming needs will require approximately 1,750 acres of beach and water; camping and picnicking will need 33,320 units and 28,200

tables, respectively. A delineation of these data for the four subareas is presented in Exhibit 36.

Multi-use

The land and water areas cited as needed in Table 59 are the areas to take care of a particular type of recreation. Much of the land and water area required can be used to satisfy several needs either concurrently or at different seasons of the year. Thus, camping and picnicking areas may serve the same need. Fall and winter hunting areas specified by the BSF&W may serve as summer nature, hiking, and camping areas. As yet, recreation resource planners have not developed sufficiently refined techniques to say how much of an area can serve dual purposes. This depends upon the nature of the particular area.

Multi-purpose is a term used frequently where water resource areas are concerned. Its connotation in these instances is the multiple use of a water area for other than recreation. Considering the use of water areas for just recreation, there are some compatible uses. For example, there can be fishing and esthetic enjoyment together with some types of boating, but not necessarily waterskiing and fishing in the same immediate area.

With regard to other uses, water areas may serve several needs; e.g., municipal water use, flood control, and electric power generation. It may not be possible for each multi-use project to be operated at maximum capacity and still allow the project to be used for the greatest number of purposes. The shortage of available water areas makes this a manifest necessity.

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POTENTIAL FOR WATER AND RELATED LAND RESOURCE DEVELOPMENT

WATER RESOURCES DEVELOPMENT POTENTIAL

Physical Potential

The topography of the Study Area is well-suited for reservoir impoundments. Occasionally, ample storage was not available in tentative site locations in the Texas Blackland Prairie LRA. Practically unlimited possibilities exist in other land resource areas. Optimum storage development for reservoirs was considered to be about twice the average annual runoff above the site, or physical or cultural limitations of the individual site.

In the upper part of the Study Area in Bryan County, Oklahoma, the average annual runoff is about eight inches. Required flood detention storage is about 5.6 inches and required sediment storage is about 1.5 inches. This leaves approximately the average annual runoff available for other uses.

In the lower part of the Study Area in Rapides Parish, Louisiana, the average annual runoff is about 15 inches. Required flood detention storage is about 8.4 inches and required sediment storage is about 0.6 of an inch. This leaves about 1-1/2 times the annual runoff available for other uses.

Additional ground water development may be undertaken anywhere in the Study Area. The aquifers that underlie the Southern Coastal Plain LRA can provide the largest yields. The combined aquifers can provide an estimated 800 m.g.d. yield of fresh water which is substantially more than is presently used. Of course, optimum withdrawals would depend upon the proper distribution and pumpage from wells throughout the aquifer. Large areas of unexplored or underdeveloped ground water are available to meet future needs.

Channel improvement and associated reservoirs can contribute greatly to flood prevention in upstream watersheds. Channel improvement for drainage in flatlands can contribute greatly to drainage needs. The need for levees is confined largely to Red River alluvial land or along major tributary streams. In some areas, levees or floodwalls in combination with channel improvement will be needed for urban area flood protection.

The potential for supplemental irrigation development is distributed throughout the four states. More than half the total potential is in Louisiana. Only 40 percent of the total potential could be project-type development, which is confined to the alluvial land along Red River. Only 18 percent of the project-type development can be irrigated safely with present quality Red River water. Individual-type development, which represents about 60 percent of the potential, can be done safely with ground water or small surface impoundments.

The potential for recreation and fish and wildlife development involves more than an appraisal of natural resources alone. The potential

depends upon a combination of physical, social, economic, and other factors. Studies point up a vast shortage of recreational facilities in almost every category. The physical potential to meet these shortages will not be a limiting factor in meeting these needs.

Projects Needed for Initial Development

The land and water resource programs urgently needed by 1980 consist of land treatment measures, multiple-purpose watershed projects, and single-purpose reservoir development. These programs are recommended for early action and the data for these programs are summarized in a later section of this Appendix.

Land treatment practices will be applied through the going Public Law 46 program and the Public Law 566 program. Emphasis will be placed on practices that reduce erosion, improve tilth, and contribute to increased farming efficiency.

Fifty multiple-purpose watershed projects in 52 CNI watersheds are feasible and needed to alleviate watershed problems and meet estimated needs. Thirteen of these projects in 14 CNI watersheds have been approved for operations since 1962. The projects would provide measures to reduce damage from erosion, sediment, and flooding, to improve drainage, and to provide water for municipal, industrial, recreation, water quality control, and irrigation purposes. Watershed locations are shown in Figure 13.

Single-purpose reservoirs to meet estimated shortages are needed on National Forest System Lands and on private lands. Seven recreational reservoirs are needed in the Ouachita National Forest in Arkansas and Oklahoma. Nine additional reservoirs on private lands are needed; four for municipal and industrial purposes and five for recreational purposes. Reservoir locations are shown on Figure 14.

Multiple-Purpose Projects for Long-Range Development (to 2080)

CNI Watersheds 3-22 and 3-26 in the Intervening Areas, Oklahoma, 3j-2 in Little River Tributary Basin, Arkansas, 3-30 in the Intervening Areas, Texas, 3k-15 in the Sulphur River Tributary Basin, Texas, and 3-57a in Posten Bayou Tributary Basin, Louisiana, are considered potentially feasible for project development after 10-15 years. An aggregate area of approximately 805 square miles is included in these potential projects. Project locations are shown in Figure 13.

Flooding, erosion, and sedimentation are occurring in these watersheds; however, damages attributable to these sources are relatively low in comparison to areas of more intensive use. Needs for agricultural and nonagricultural water management are apparent and are expected to increase.

Generally, local interest in these areas is insufficient for project development, but it is expected to increase as watershed conditions change and greater needs develop. Pertinent structural data are summarized in Table 60. Benefits would exceed costs of structural works of improvement.

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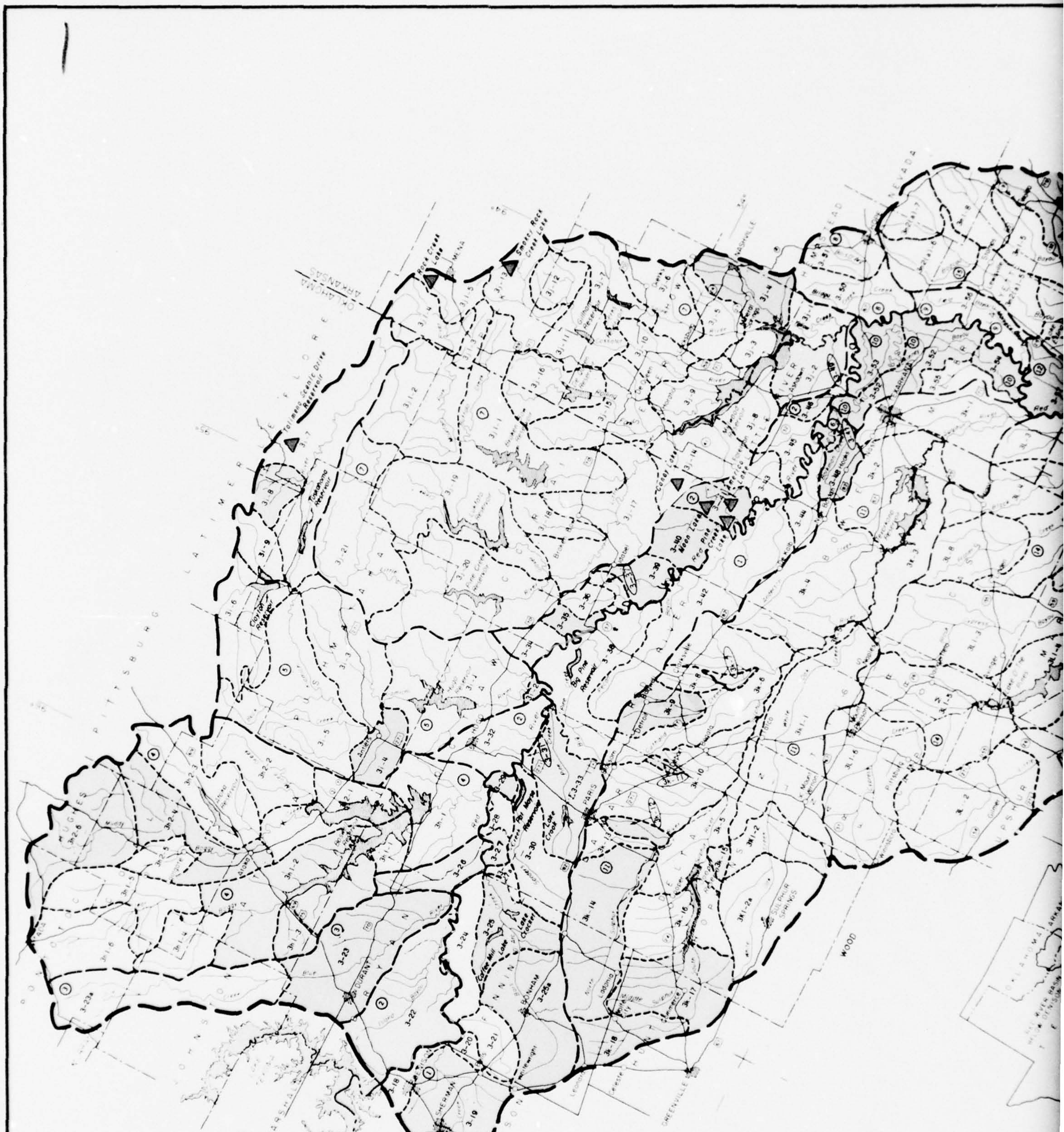
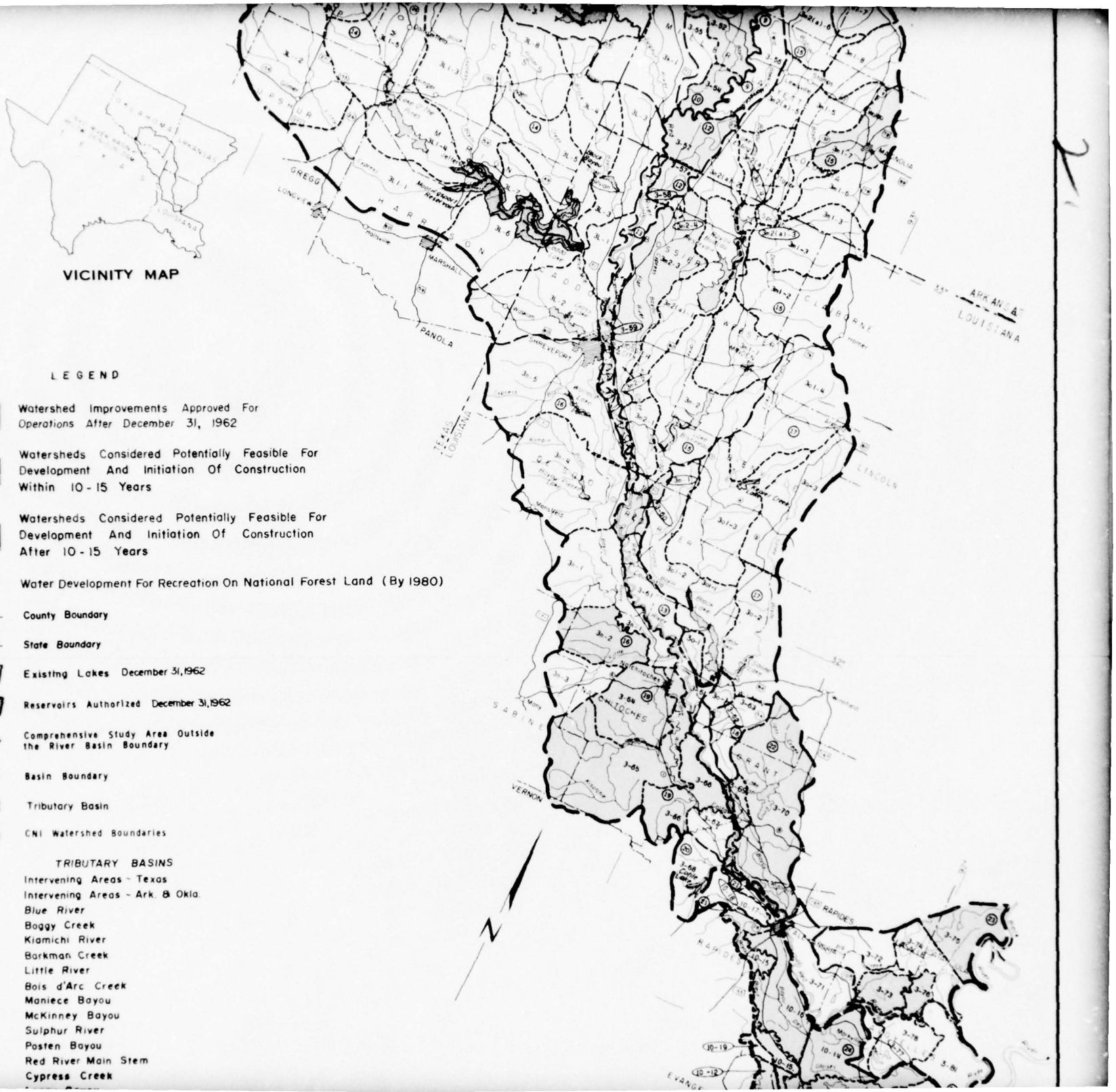

DURANT
PARIS
SHERMAN
BONHAM
SULPHUR SPRINGS
WOOD


VICINITY MAP
OKLAHOMA
ARKANSAS
LOUISIANA
TEXAS
LEGEND
Watershed Improvements Approved For Operations After December 31, 1962
Watersheds Considered Potentially Feasible For Development And Initiation Of Construction Within 10 - 15 Years
Watersheds Considered Potentially Feasible For Development And Initiation Of Construction After 10 - 15 Years
Water Development For Recreation On National Forest Land (By 1980)
County Boundary
State Boundary
Existing Lakes December 31, 1962
Reservoirs Authorized December 31, 1962
Comprehensive Study Area Outside the River Basin Boundary
Basin Boundary
Tributary Basin
CNI Watershed Boundaries
TRIBUTARY BASINS
1 Intervening Areas - Texas
2 Intervening Areas - Ark. & Okla.
3 Blue River
4 Boggy Creek
5 Kiamichi River
6 Barkman Creek
7 Little River
8 Bois d'Arc Creek
9 Maniece Bayou
10 McKinney Bayou
11 Sulphur River
12 Posten Bayou
13 Red River Main Stem
14 Cypress Creek
GREGG
HARRISON
CADDO
PANOLA
SHREVEPORT
MARSHALL
LINCOLN
NATCHITOCHES
SABINE
VERNON
RAPIDES
EVANGE
33°
32°
N

3hl-2 CNI Watershed Boundaries

TRIBUTARY BASINS

1	Intervening Areas - Texas
2	Intervening Areas - Ark. & Okla.
3	Blue River
4	Boggy Creek
5	Kiamichi River
6	Barkman Creek
7	Little River
8	Bois d'Arc Creek
9	Maniece Bayou
10	McKinney Bayou
11	Sulphur River
12	Posten Bayou
13	Red River Main Stem
14	Cypress Creek
15	Loggy Bayou
16	Bayou Pierre
17	Black and Saline Lakes
18	Nantachie Creek
19	Cane River
20	Bayou Jean de Jean
21	Bayou Rapides
22	Bayou Rigolette
23	Red River Backwater Area
24	Chatlin Lake and Associated Area

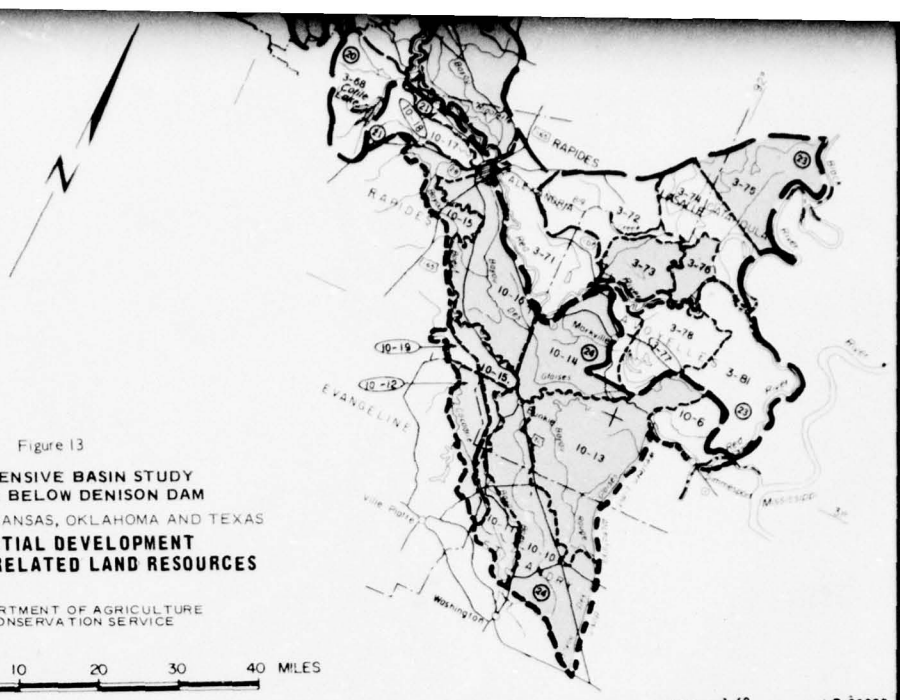


Figure 13

COMPREHENSIVE BASIN STUDY
RED RIVER BELOW DENISON DAM
LOUISIANA, ARKANSAS, OKLAHOMA AND TEXAS

POTENTIAL DEVELOPMENT
WATER AND RELATED LAND RESOURCES

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

10 0 10 20 30 40 MILES

Rev. 1-68 4-R-23022

OKLAHOMA PORTION COMPILED FROM USGS 1:500,000 BASE - REMAINDER FROM AMS 1:250,000 SHEETS.
EXISTING LAKES FROM ABOVE SOURCES SUPPLEMENTED WITH USGS QUADRANGLES AND COUNTY HIGHWAY MAPS

USDA-SCS-FORT WORTH, TEX. 1968

Rev. 1-68 4-R-20039

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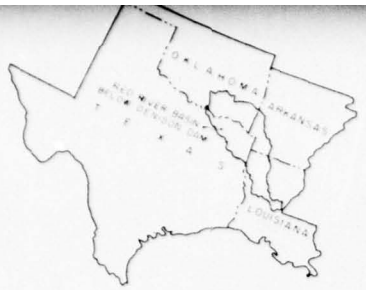

VICINITY MAP

LEGEND

- County Boundary
- State Boundary
- Existing Lakes December 31, 1962
- Reservoirs Authorized December 31, 1962
- Comprehensive Study Area Outside the River Basin Boundary
- Basin Boundary
- 3h1-6 CNI Watershed Boundaries
- Water Quality Dam Site Potentially Feasible Beyond 10-15 Years
- Municipal and Industrial Dam Site Potentially Feasible Within 10-15 Years
- Municipal and Industrial Dam Site Potentially Feasible Beyond 10-15 Years
- Recreation Dam Sites Potentially Feasible Within 10-15 Years
- Recreation Dam Sites Potentially Feasible Beyond 10-15 Years
- Irrigation Dam Sites Potentially Feasible Beyond 10-15 Years

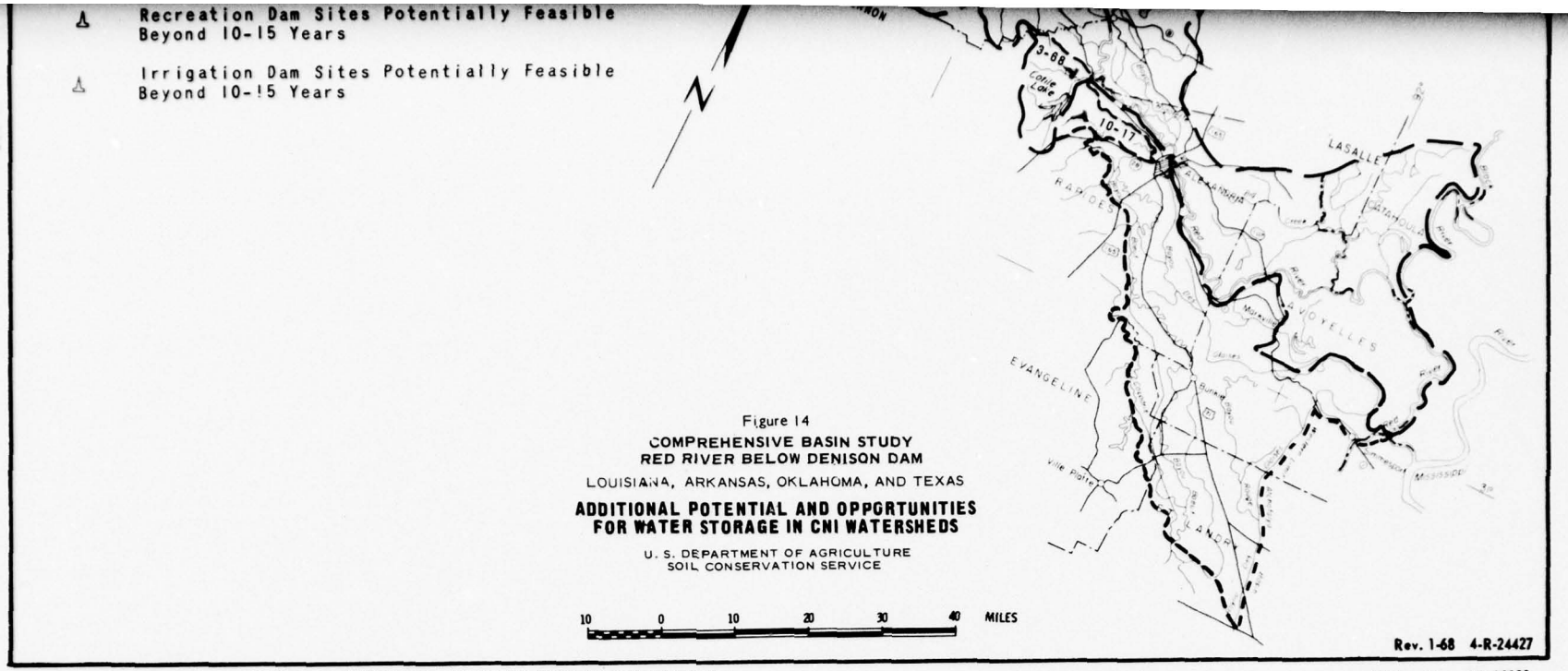

Figure 14

COMPREHENSIVE BASIN STUDY
RED RIVER BELOW DENISON DAM

LOUISIANA, ARKANSAS, OKLAHOMA, AND TEXAS

ADDITIONAL POTENTIAL AND OPPORTUNITIES FOR WATER STORAGE IN CNI WATERSHEDS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

OKLAHOMA PORTION COMPILED FROM USGS 1:500,000 BASE - REMAINDER FROM AMS 1:250,000 SHEETS.

EXISTING LAKES FROM ABOVE SOURCES SUPPLEMENTED WITH USGS QUADRANGLES AND COUNTY HIGHWAY MAPS

USDA-SCS FORT WORTH, TEX. 1968

3-64 Base 4-R-18830

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Table 60 - Pertinent Structural Data - Potential Multiple-Purpose Projects for Long-Range Development, Red River Basin Study Area

Tributary Basin and CNI Watershed	Watershed Area	Drainage Area Controlled	Structural Measures: Reservoirs	Structural Measures: Channel Improvement	Pool Capacity: Detention	Pool Capacity: Sediment	Pool Capacity: Other 1/	Surface Area of Permanent Pool 2/
	(sq.mi.)	(sq.mi.)	number	miles	(ac.ft.)	(ac.ft.)	(ac.ft.)	acres
Intervening Areas - Texas								
3-30	184	53	11	6.3	18,120	9,878	0	760
Total	184	53	11	6.3	18,120	9,878	0	760
Intervening Areas - Arkansas and Oklahoma								
3-22	334	74	7	0	22,400	3,360	0	265
3-26	113	34	5	0	11,385	1,855	0	220
Total	447	108	12	0	33,785	5,215	0	485
Little River								
3j-2	116	0	0	8.0	0	0	0	---
Total	116	0	0	8.0	0	0	0	---
Sulphur River								
3k-15	15	11	4	-	3,806	2,282	0	220
Total	15	11	4	-	3,806	2,282	0	220
Posten Bayou								
3-57a	43	4	1	16.0	1,948	249	276 R	60
Total	43	4	1	16.0	1,948	249	276	60
Grand Total	805	176	28	30.3	57,659	17,624	276	1,525

1/ Abbreviations: R- Recreation
2/ Total surface area at principal spillway elevation

Coordination with Plans of Other Agencies

Other agencies prepared plans for water and related land resource development. The USAE and the TWDB plans include recommendations for projects to be initiated within the next 10-15 years. Projects include reservoir storage for municipal and industrial water supply, water quality control, power, irrigation, recreation, flood control, and unassigned conservation storage. Durant Reservoir was recommended for early-action development by the USAE. The USDA recommended an early-action plan for CNI Watershed 3-23 (Lower Blue River) that does not include Durant Reservoir; however, the USDA does not object to inclusion of Durant Reservoir in the long-range plan. Channel improvement projects serve flood control and drainage purposes. The USAE has submitted an interim report for the navigation project.

Projects identified by the USAE and the TWDB for long-range development are predominantly reservoir projects for flood control and conservation storage. Red River navigation from Shreveport, Louisiana, to Denison Dam and the Loggy Bayou Ring Levee also are included in the long-range development plan.

USDA potential development was based on data developed by USDA and on needs data developed by other agencies and submitted by them to the FCC. Needs for irrigation development were prepared jointly by the BR and USDA and are described in Appendix VI; needs for drainage improvements are described in Appendix VII.

Other Potential and Opportunities for Long-Range Development

Storage opportunities for water quality, municipal and industrial

water supply, recreation, and irrigation needs beyond the next 10-15 years were investigated. Two water quality reservoirs, five municipal and industrial water supply reservoirs, thirty-four recreation reservoirs, and nineteen irrigation reservoirs were identified. Locations of these reservoir sites are shown in Figure 14. The total estimated storage capacity of the reservoirs is 1,590,490 acre-feet. Of this amount, approximately 5,900 acre-feet would be for water quality, 27,130 acre-feet for municipal and industrial water storage, 436,770 acre-feet for recreation, 287,220 acre-feet for irrigation, 56,825 acre-feet for sediment accumulation, and 776,645 acre-feet would be available for additional potential storage. The total surface area of the permanent pools would be approximately 58,040 acres of which 32,870 acres would be for recreational use. Approximately 776,645 acre-feet of additional storage that would not be needed for water quality, municipal and industrial, recreation and irrigation could be developed. Reservoir storage data are shown in Table 61.

Recreation and irrigation water supply needs identified for development beyond 10-15 years exist in watersheds considered potentially feasible for initial development. Recreation facilities and storage opportunities in the vicinity of Paris, Texas, could be provided in one site in CNI Watershed 3-30 and one site in CNI Watershed 3-33. Recreation storage opportunities for Lewisville, Arkansas, could be provided in one site in CNI Watershed 3-56. One site located in CNI 3k-16 could supply recreation storage for the Cooper, Texas, area. Recreation needs in the vicinity of Commerce, Texas, could be met with one site identified in CNI Watershed 3k-17.

The Town of Lewisville, Arkansas, has municipal and industrial water supply needs for 2080 which could be satisfied in one reservoir located in CNI Watershed 3m2(a)-5. The 2030 municipal and industrial water supply needs for Bossier City, Louisiana, could be satisfied in one reservoir located in CNI Watershed 3m2(a)-2. The 2080 municipal and industrial water supply needs for the Town of Mansfield, Louisiana, could be met in one reservoir located in CNI Watershed 3n-4. The Towns of Coushatta and Montgomery, Louisiana, have 2080 municipal and industrial water supply needs that could be supplied with one reservoir in CNI Watershed 3ol-2 and one reservoir in CNI Watershed 3-63, respectively.

Irrigation needs appraisals indicate that water supply requirements for project-type irrigation development would have to be provided from surface sources. Nineteen reservoir sites were identified which would provide opportunities for irrigation storage development beyond 10-15 years. Eight sites were located in Oklahoma, four in Texas, two in Arkansas, and five in Louisiana.

The BR in their Goodland Project and Liberty Bottoms Project shows flows of Red River and ground water as a water supply source for irrigation. Since the quality and quantity of water from these sources are marginal, potential reservoir sites were located which could supplement these sources. All sites were located on minor tributaries to Red River; however, as future needs increase, it may be necessary to use storage potentials which are available upstream in most of the major tributaries. Two areas with

Table 61 - Pertinent Structural Data- Additional Storage Potential for Long-Range Development, Red River Basin Study Area

Tributary Basin and CNI Watershed	Number of Structures	Drainage Area Above Structure (sq. mi.)	Pool Capacity (ac. ft.) Water Quality	Recreation	Municipal and Industrial	Irrigation	Sediment	Surface Area of Permanent Pool (acres)	Additional Storage Capacity (ac. ft.)
Potentially Feasible Watersheds for Development									
Intervening Areas - Texas									
3-30	1	16.9	---	18,000	---	---	900	1,330	0
3-33	1	5.6	---	5,970	---	---	300	500	0
Subtotal	2	22.5	---	23,970	---	---	1,200	1,830	0
Intervening Areas - Arkansas and Oklahoma									
3-22	6	64.5	---	---	---	41,400	5,200	2,850	0
Subtotal	6	64.5	---	---	---	41,400	5,200	2,850	0
Sulphur River									
3k-17	1	9.5	---	3,450	---	---	510	320	4,140
Subtotal	1	9.5	---	3,450	---	---	510	320	4,140
Posten Bayou									
3-57a	1	6.4	---	---	---	10,020	160	800	0
Subtotal	1	6.4	---	---	---	10,020	160	800	0
Total	10	102.9	---	27,420	---	51,420	7,070	5,800	4,140
Watersheds Considered Not Potentially Feasible for Development									
Intervening Areas - Texas									
3-24	1	6.0	---	3,450	---	---	320	320	1,350
3-27a	1	14.6	---	---	---	11,380	790	760	0
3-42	3	102.9	---	---	---	67,900	3,540	5,040	34,400
3-42	1	12.4	---	9,600	---	---	660	740	17,840
Subtotal	6	135.9	---	13,050	---	79,280	5,310	6,860	53,590
Intervening Areas - Arkansas and Oklahoma									
3-32	1	11.2	---	---	---	8,700	910	650	0
3-37	1	21.0	---	---	---	23,100	730	1,680	10,840
Subtotal	2	32.2	---	---	---	31,800	1,640	2,330	10,840
Klamichi River									
3i-1	1	7.1	---	2,570	---	---	380	250	4,620
Subtotal	1	7.1	---	2,570	---	---	380	250	4,620
Little River									
3j-15	1	10.6	---	12,100	---	---	450	900	7,250
3j1-4	1	16.5	---	4,800	---	---	700	410	29,700
Subtotal	2	27.1	---	16,900	---	---	1,150	1,310	36,950
McKinney Bayou									
3-55	1	35.3	---	---	---	21,870	1,940	1,680	33,400
Subtotal	1	35.3	---	---	---	21,870	1,940	1,680	33,400
Sulphur River									
3k-16	1	11.8	---	4,010	---	---	630	375	7,960
3k-1	1	33.5	---	23,000	---	---	1,430	1,550	32,770
3k-4	1	4.6	---	4,000	---	---	250	320	3,110
3k1-1	1	6.0	---	5,800	---	---	320	480	4,080
3k1-2a	2	56.5	---	20,130	---	---	3,020	1,520	37,150
3k1-2a	1	8.5	1,900	---	---	---	450	220	6,700
Subtotal	7	120.9	1,900	56,940	---	---	6,100	4,515	91,770
Cypress Creek									
3L-4	1	28.5	---	23,480	---	---	1,520	1,680	17,600
3L-8	1	44.8	---	22,610	---	---	2,390	1,680	41,900
3L1-3	1	9.1	---	9,300	---	---	490	720	2,810
3L1-5	1	21.6	---	8,600	---	---	1,150	670	27,150
3L1-1	2	29.5	---	18,800	---	---	2,100	1,445	33,100
3L1-2	2	38.8	---	23,200	---	---	2,065	1,740	24,335
3L1-6	1	33.2	---	13,500	---	---	1,770	990	41,330
3L1-2	1	5.3	4,000	---	---	---	230	340	5,000
3L-3	1	26.6	---	---	---	22,350	1,460	1,680	19,000
Subtotal	11	237.4	4,000	119,490	---	22,350	13,175	10,945	212,225
Loggy Bayou									
3m2(a)-2	1	80.6	---	---	15,500	---	4,300	2,310	24,380
3m1-3	1	31.1	---	23,670	---	---	1,330	1,680	28,100
3m2(a)-5	1	2.8	---	---	500	---	150	70	4,150
3m2(a)-7	2	25.6	---	30,800	---	---	1,100	2,280	20,400
3m1-2	1	37.3	---	23,410	---	---	1,590	1,680	40,600
Subtotal	6	177.4	---	77,880	16,000	---	8,470	8,020	117,630
Maniece Bayou									
3-56	1	5.8	---	5,250	---	---	250	440	4,400
Subtotal	1	5.8	---	5,250	---	---	250	440	4,400
Bayou Pierre									
3n-1	4	87.5	---	---	---	80,500	3,700	5,860	58,700
3n-4	2	42.0	---	13,000	8,440	---	1,810	2,330	39,240
3n-5	2	54.0	---	39,700	---	---	2,300	2,830	44,400
Subtotal	8	183.5	---	52,700	8,440	80,500	7,810	11,020	142,340
Black and Saline									
3ol-2	2	42.0	---	23,470	1,700	---	1,810	1,850	41,920
3ol-4	1	25.7	---	23,900	---	---	1,100	1,680	18,800
3o-3	1	10.4	---	17,200	---	---	300	1,210	120
Subtotal	4	78.1	---	64,570	1,700	---	3,210	4,740	60,840
Nantachie Creek									
3-63	1	7.3	---	---	990	---	320	130	3,900
Subtotal	1	7.3	---	---	990	---	320	130	3,900
Total	50	1,048.0	5,900	409,350	27,130	235,800	49,755	52,240	772,505
Grand Total	60	1,150.9	5,900	436,770	27,130	287,220	56,825	58,040	776,645

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the most favorable storage potential are Cypress Creek and Little River Tributary Basins. Other good storage possibilities exist in the Loggy Bayou and Black and Saline Lake Tributary Basins. Most of these storage possibilities would necessitate long delivery systems.

Watershed Development Alternatives

The SCS participated with the USAE in the development of several potential project plans that are alternates to the potential upstream watershed projects. Alternate potential project plans were developed for several potential watershed multiple-purpose projects proposed for initial development. One alternate plan was prepared for a potential project for long-range development. Alternates for developing irrigation water supplies also were investigated.

Multiple-Purpose Projects for Initial Development

The SCS formulated with the USAE alternate multiple-purpose plans on a project by project basis. Alternate plans were developed for two potential watershed projects in Texas, three watershed projects in Oklahoma, and one project in Louisiana.

Benefits were allocated equitably to elements of the combined projects by mutual agreement of the two planning agencies. Details for these projects are given in the section describing projects recommended for early action.

Multiple-Purpose Projects for Long-Range Development

CNI Watershed 3-22 (Island Bayou) was placed in the category for long-range development by USDA. The USAE, in their investigation of this watershed, proposed improvements for initial development. If, however, the USAE project (Albany Reservoir) is not installed, the potential upstream watershed project would become an alternate plan of development. Data for this project are included in Table 60.

Alternatives for Irrigation Water Supply

Initial Development

The USAE have identified a potential reservoir for initial development for utilizing storage for irrigation purposes. The Kisatchie Reservoir, Louisiana, has about 47,000 acre-feet of storage allocated for irrigation. This storage is an alternate to the irrigation storage described for potential upstream watershed early-action projects in Cane River Tributary Basin Watersheds.

Long-Range Development

Irrigation would be confined primarily to the Southern Mississippi Valley Alluvium LRA. Soils in this LRA are located adjacent to Red River and have the greatest potential for future irrigation development. The

estimated maximum gross water requirement to meet the 1980-2080 needs is 1,814,100 acre-feet. About 1,108,900 acre-feet would be needed for individual-type development and 705,200 acre-feet would be needed for project-type development between 1980 and 2080.

Alternates for developing irrigation water supplies are available to meet 2030 and 2080 needs. A summary of irrigation water supply project-type needs by States for 2030 and 2080 follows:

State	2030	2080
	acre-feet	
Arkansas	118,300	236,500
Louisiana	129,300	258,700
Oklahoma	75,000	150,000
Texas	30,000	60,000
Total	352,600	705,200

Irrigation investigations made by the BR indicate that Red River flows will satisfy all future irrigation water requirements provided that both suitable drainage outlets and ample surface water for leaching are available. Water quality records show that Red River water during low flow periods, the periods irrigation water would be needed, is high-salinity water. This water would be restricted to use on coarse textured soils. However, projects are being installed that would reduce the salt content of Red River water and would make it more suitable for irrigation use. Also, Red River water quality could be improved by releases from planned tributary reservoirs. Even so, the limitations involved in using Red River water for irrigation purposes indicate a need for alternate irrigation water supplies.

The USDA identified 19 potential reservoir sites that could be used as an alternate water supply to Red River. The sites are located on laterals to Red River and they could be used either to supplement water taken from Red River or to furnish the entire supply for several of the small, noncontiguous areas suitable for irrigation. Generally, the quality of water from these reservoirs would have no limitations for irrigation use. Reservoir site locations are shown in Figure 14.

Approximately 287,200 acre-feet of irrigation storage could be developed in CNI watersheds in the 19 potential reservoir sites. Eight reservoirs with a total storage of approximately 73,200 acre-feet could be located in Oklahoma. Four reservoirs with approximately 79,300 acre-feet could be located in Texas. Two reservoirs with approximately 44,200 acre-feet could be located in Arkansas. Five reservoirs with approximately 90,500 acre-feet could be located in Louisiana. The 287,200 acre-feet of storage in potential reservoirs would not supply all of the 2030 project-type irrigation needs.

The two reservoirs located in Arkansas would provide approximately 37 percent of the 2030 water requirements needed for project-type irrigation. Approximately 70 percent of the 2030 project-type water

requirements in Louisiana could be stored in five reservoirs. Eight reservoirs in Oklahoma could supply approximately 98 percent of the 2030 project-type irrigation water requirements for that State. The potential irrigation storage identified in Texas is greater than that needed to satisfy the 2080 needs. This storage is not available for use on all lands because of reservoir location.

The locations of the laterals into Red River, in relation to potentially irrigable land, limit reservoir irrigation storage potential. Reservoir sites for supplemental irrigation water storage are not available in CNI Watershed 3-29, Texas. The Pat Mayse Reservoir, Texas, which is located adjacent to this watershed, has 124,500 acre-feet of water supply storage which has been allocated to other purposes. This reservoir is ideally located to furnish irrigation to CNI Watershed 3-29, Texas. In the future, if water needs for other purposes change, water from Pat Mayse Reservoir should be considered for irrigation.

The intervening areas between potential reservoir sites would have to use water from Red River as a supplement to surface water storage in order that the remaining 2030 needs could be satisfied. Remaining 2080 water requirements for Arkansas, Oklahoma, and Louisiana would have to be supplied from Red River.

LAND RESOURCE DEVELOPMENT POTENTIAL

Agriculture

Land resource development is concerned with land and water uses that will yield continuing returns to the people of the Study Area and of the Nation. A development program places emphasis on accelerating the land treatment measures that have a significant effect on reducing runoff, erosion, and sediment production. The measures are designed to protect and improve the agriculture and woodlands and increase overall farming efficiency. Thus, to meet the Study Area's share of the expanding National market demands, farmers will need to capitalize on the potential of land resource development. This can be accomplished by the adoption of improved crop and livestock production and, insofar as practical, use of land according to its capabilities.

In addition, farmers will need to make some adjustments in land use such as (1) clearing and draining wet land capable of profitable crop and pasture production and (2) shifting idle land to crop or pasture uses. On the other hand, some land now idle, in crops, or in pasture should be reforested. Improved technology and its rate of acceptance and adaptation by farmers represents another potential for land resource development. Better communications, larger farms, and greater managerial ability will accelerate the physical development of underdeveloped lands being used below their capabilities. As a result, a greater portion of the agricultural area will be utilized for production of the more intensive crops and improved pasture, the location of which will tend to shift to the more productive, less hazardous soils.

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A major objective in the physical resource development program will be to control erosion on 1,972,000 acres of sloping cropland. The major land treatment practices to be applied include terraces, contour farming, grassed waterways, and special residue management. A cropping system designed to reduce erosion to a minimum is necessary to prevent resource deterioration.

About 95,500 acres, now classified as cropland, are too steep and eroded for cultivated crops. This land should be seeded to permanent grass and used for meadow or pasture. Some of it may be converted to woodland, wildlife land, or recreational areas.

About 1,810,700 acres of Southern Mississippi Valley Alluvium and Southern Mississippi Valley Silty Uplands have a wetness problem. Most of this surface ponding or wetness, which originates from high land runoff, is aggravated by stream overflow. Diversion terraces placed to intercept runoff from the high areas and convey the water to natural outlets through surface field ditches will help alleviate the on-farm drainage problem. Control structures may be needed where the field ditches empty into the stream. Land grading and smoothing, combined with a cropping system designed to prevent deterioration of soil structure, are some practices needed on lands with wetness problems.

Approximately 765,600 acres, distributed throughout the four states in the Study Area, have a potential for irrigation development. More than half of this acreage is in Louisiana. Of the total area, approximately 317,000 acres are suitable for project-type development, and 448,600 acres could be developed individually by landowners and operators. Approximately 57,500 acres of the land suitable for project-type development would be feasible by 1980. Land shaping and other practices for water management would be needed on these lands.

The CNI indicates that nearly 41 percent, or 1,851,800 acres, of the grazing and pastureland has adequate cover to prevent soil erosion. However, for grazing and pasturelands to produce sufficient grazing to yield an economic return, at least 1,558,800 acres should be treated. High-level management of pastureland is accomplished by liming, fertilizing, reseeding improved pasture mixtures, and by fencing and developing additional water supplies for proper grazing control.

About 33 percent of the 10,286,400 inventoried acreage of forest and woodland in the Study Area is on land-capability Classes VI and VII. Lands in these capabilities are suited only to grass, tree production, and wildlife and recreational areas. Forty-eight percent is in capability Classes I to IV. Capability Class V accounts for the remaining 19 percent of the woodland area and is so classified because of a wetness problem. With land treatment measures applied, this land in capability Classes I through V, or about 6,900,000 acres, could be used for cultivation, if needed to meet the future crop production needs.

Forestry

Table 62 shows estimates at the 1962 level of treatment measures

recommended for forest lands of the Study Area. These measures are needed if full benefits in watershed management and wood productivity are to be realized. Installation of the recommended measures would require that all private, non-forest industry lands be put under good forest management and sustained yield.

Table 62- 1962 Quantity and Costs of Recommended Forest Land Treatment, Red River Basin Study Area

Measure	Quantity			Costs 1/
	Total Needs	Going Program	Recommended Program	Installation
	thousand acres			thousand dollars
Openland tree planting	213.0 2/	136.0 3/	77.0	1,256.5
Forest interplanting	880.0	290.5 4/	589.5	10,432.0
Hydrologic stand improvement	2,693.3	538.7 4/	2,154.6	11,421.5
Forest grazing control	644.0 5/	-	644.0	2,414.7 6/
Total	4,430.3	965.2	3,465.1	25,524.7

1/ 1962 level
2/ Idle, depleted, poorly protected agricultural lands
3/ Total for 1962-80 at current rate
4/ On Federal and forest industry lands
5/ Unprotected forest land with moderate or heavy damage
6/ Does not include annual maintenance costs of $128,800

Since 1962, a portion of the recommended measures have been installed under going programs and accelerated programs of small watershed (P.L. 566) projects. There is evidence that some of the forest land recommended for treatment in Table 62 has recently come under control of forest industry with a higher level of management, but the great bulk of the 1962 acreage needing treatment is still without a good management program.

Table 63 shows the estimated quantity and costs of the technical assistance needed to install the forest land treatment measures recommended in Table 62.

Table 64 shows the quantity and costs of improvements in fire protection recommended for forest lands of the Study Area. No broad improvement in forest land management would be feasible without added assurance against untoward losses from wildfire. Protection of the capital invested in accelerated land treatment and water management values added by improved fire protection would justify the intensified program for the Study Area.

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Table 63 - 1962 Quantity and Costs of Technical Assistance for Installation of Recommended Forest Resource Improvement Measures, Red River Basin Study Area

State	Quantity			Cost 1/	
	Total Needs 2/	Going 3/ Program	Recommended Program	Installation	Annual 4/
	thousand acres			thousand dollars	
Arkansas	546.8	-	546.8	12	34.0
Louisiana	1,080.4	300.0	780.4	18	51.0
Oklahoma	1,265.7	120.0	1,145.7	24	68.0
Texas	1,103.5	180.0	923.5	21	59.5
Total	3,996.4	600.0	3,396.4	75	212.5

1/ 1962 Cost level
2/ Based on 1962 conditions and 1962 level of accomplishment
3/ Does not include programs on Federal, State, and forest industry lands
4/ For estimated 15-20 year program

Table 64 - Quantity and Added Costs of Recommended Fire Protection 1/ Measures, Red River Basin Study Area

State	Total Needs	Federal Lands	Total State and Private Lands	Going State 2/ Program	Recommended Additional Protection		Added Annual Costs		Total Added Annual Costs
					Area	Installation Costs	On New Area	On Established Area	
	thousand acres				thousand dollars				
Arkansas	2,022.2	106.9	1,915.3	1,916.4 3/	-	-	-	76.7	76.7
Louisiana	3,513.9	316.6	3,197.3	3,193.2 4/	-	-	-	129.3	129.3
Oklahoma	3,195.3	135.6	2,990.2	1,997.0	875.4 5/	48.5 6/	101.5	143.4	244.9 7/
Texas	2,239.5	99.7	2,139.8	2,139.8	-	-	-	73.6	73.6
Total	10,970.9	658.7	10,242.6	9,386.4	875.4	48.5	101.5	423.0	524.5

1/ Based on 1962 acreages in Study Area. Cost estimates based on 1963 costs of protection.
2/ 1962
3/ Includes 1,100 acres of Federal land
4/ Includes 35,900 acres of Federal land
5/ Includes 385,200 acres for nonintensive protection
6/ At 3-1/8 percent, amortized for 15 years: Annual Costs = $0.0014/acre on 2,844,600 acres
7/ Does not include installation costs for added acreage

Table 65 shows land treatment measures planned for National Forest System Lands on the Study Area, for the period July 1, 1966, through 2010. Except for channel stabilization, the measures listed are regular and continuing programs under management of National Forest System Lands.

Regular USFS funds and share of timber sale and grazing revenues established by Federal law are expected to cover the costs of installation for the land treatment measures listed in Table 65.

Table 65 - Future Land Treatment 1/ Needs for National Forest System Lands, Red River Basin Study Area

	Unit	7/1/66 Thru 1980	1981 Thru 2010	Total
Tree planting	Acre	37,843	124,379	162,222
Timber stand improvement	Acre	200,943	218,679	419,622
Erosion control	Acre	3,474	6,817	10,291
Range improvement	Acre	680	800	1,480
Channel stabilization	Mile	29	36	65
Total	Acre	242,940	350,675	593,615
Total (channel stabilization)	Mile	29	36	65

1/ Mostly recurring

Programs for Potential Development

USDA water and related land resource programs also are being developed under authorities other than P. L. 566. The FHA provides financial assistance to rural communities for water supply improvements, as well as watershed development. The FHA also is authorized to make loans for recreation enterprises to farmers and ranchers who personally manage and operate units that are not larger than family farms. These loans are designed for helping borrowers develop recreation enterprises that will supplement farming income. Loans also may be made to nonprofit organizations for development of recreation enterprises.

The Agricultural Stabilization and Conservation Service (ASCS) administers several USDA programs. The Cropland Adjustment Program (CAP) authorized by the Food and Agricultural Act of 1965 provides for long-term diversion of land currently being used for production of surplus crops to conservation and other beneficial uses such as expansion of recreation, wildlife habitat, and reforested areas. A special section of the CAP helps State and local agencies to purchase cropland and establish on it practices and uses for preservation of open spaces and natural beauty, development of wildlife or recreational facilities, and prevention of air and water pollution. The Cropland Conversion Program assists farmers in converting cropland that is now surplus crop production to wildlife and recreational uses. The contracts to divert land being used for production of commodities into conservation uses, under the Conservation Reserve Program, can be modified to change the land use from vegetative cover to wildlife and recreational uses. The Agricultural Conservation Program, also administered by the ASCS, provides cost-sharing assistance to farmers who are interested and willing to establish soil and water conservation practices on their farms.

The SCS provides technical assistance to landowners and operators, through Soil and Water Conservation Districts, with planning, installation, and maintenance of soil and water conservation practices. Technical

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assistance is also available for the planning and installation of income-producing recreation enterprises as a phase of soil and water conservation and proper land use. Income-producing recreation enterprises on private land, as differentiated from those on public land, are defined as recreation enterprises which are planned and developed as a use of land and water resources to provide service to the public through private economic enterprise. This program is administered by the SCS under authority of P. L. 46.

The Resource Conservation and Development Projects (RC&D) Program is administered by the SCS with participation by other USDA agencies. Agencies outside the USDA who may have interests in program activities also are invited to participate. The program provides for development of locally initiated and sponsored projects designed to provide additional economic opportunities to rural areas.

A Resource Conservation and Development Project Plan has been developed for Bossier and Webster Parishes, Louisiana, under the authority of Public Law 87-703 (Food and Agriculture Act of 1962). The primary objective of the plan, and ultimately the project, is to develop and use wisely natural resources for economic growth and to provide for the needs of people in and outside the project area. The project includes three multiple-purpose reservoirs and 9.4 miles of channel improvement in addition to those previously listed for CNI watersheds. Annual benefits of $141,200 are expected from the improvements. Total installation cost is estimated to be $2,785,000. Annual costs, including operation and maintenance, are estimated to be $95,800.

The plan also incorporates CNI Watershed 3m2-4 (Upper West Fork of Cypress Bayou), which was authorized prior to December 31, 1962, CNI Watershed 3m2-3 (Cypress-Black Bayou), authorized for operations after 1962, and CNI Watershed 3-57 (Posten Bayou), which is considered potentially feasible for development after 10-15 years. These three watersheds have been included in previous discussion of watershed projects for potential development.

There are 15 other potential reservoir sites located throughout the two parishes that can be developed to conserve soil and water and bring about improved land utilization. Other uses could be for irrigation, municipal, industrial, and recreation purposes. Structures on these 15 potential sites could be installed with technical and financial assistance from RC&D funds. The total estimated cost for installing these structures is about $16,000,000.

Other similar opportunities may develop for planning and installing resource conservation and development projects. Project starts are dependent upon local initiative.

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IMPACTS ON AGRICULTURAL PRODUCTION

Physical

The influence of programs and projects proposed to help satisfy the food and fiber requirements in the Study Area is expected to bring about major land use changes. Table 66 presents 1980 land utilization and large water area with no further acceleration in the rate of resource development (without project), and the land use changes with an acceleration in the rate of resource development under proposed programs and projects to satisfy agricultural requirements and increases in urban and built-up area (with project).

Table 66 - Inventory, Non-Inventory, and Water Area: Without and With Project Development, Red River Basin Study Area, 1980 1/

Major Uses	Without Project	With Project 2/
	- - - - - thousand acres - - - - -	
Inventory:		
Cropland	2,864.8	3,762.7
Crops & related uses 3/	1,655.6	2,090.0
Used only for pasture	1,209.2	1,672.7
Pasture-range	3,268.1	2,726.7
Forest-woodland	10,703.9	9,794.9
Other lands 4/	413.0	497.7
Total inventory	17,249.8	16,782.0
Non-inventory:		
Federal land	694.1	694.1
Urban & built-up	586.7	628.7
Small water areas	86.1	100.1
Total non-inventory	1,366.9	1,422.9
Total land area	18,616.7	18,204.9
Large water area	333.6	745.4
Total land and water area	18,950.3	18,950.3

1/ See Exhibits 5 and 37

2/ These data are compiled from information furnished by the SCS and USAE

3/ Cropland harvested, crop failures, and cultivated summer fallow, soil improvement crops, and idle cropland

4/ Farmsteads, farm roads, idle land, wildlife, and recreation areas

By 1980, 897,900 acres of pasture-range and woodland will shift into cropland use. An additional 41,900 acres will shift into urban and built-up areas. Within the farm land area, there are anticipated variations in the pattern of land distribution between the major land uses. Extensive clearing of hardwoods and other timber in the bottomlands of the Southern Mississippi Valley Alluvium land resource area is

changing the pattern of crop acreages and crop distribution. Exhibit 37 shows for 1980 a detailed inventoried land use with crop distribution by land resource area groupings with the proposed programs and projects. This land utilization of cropland would satisfy food and fiber requirements allocated to the Study Area.

The 1980 production requirements for nonfeed crops require a 42 percent increase in the projected trends of nonfeed crop acreages (table 67). This acreage increase is due largely to the soybean requirement, which requires a 280 percent increase from the present trend. However, cotton acreages can be reduced approximately 95,000 acres and still satisfy production requirements. Other nonfeed crops can be expected to be met with minor variations in the normal pattern of crop production at yields attainable through technological improvement and water resources development.

Table 67 - Feed and Non-feed Crop Acreages: Without Further Resource Development, and With an Acceleration in the Rate of Resource Development, to Satisfy Food and Fiber Requirements, Red River Basin Study Area, 1980

Crop or crop group	Without project development	Project development to satisfy needs
	thousand acres	
Non-feed crops		
Wheat	102.4	222.3
Cotton	232.2	137.6
Sweet potatoes	20.0	43.0
Non-citrus fruit	14.8	11.3
Vegetables	21.6	22.8
Peanuts	28.0	56.1
Miscellaneous	49.4	49.4
Soybeans	51.7	196.4
Total	520.1	738.9
Feed crops, hay, and pasture		
Corn, grain	45.9	41.1
Sorghum, grain	73.7	117.4
Oats	58.1	38.4
Barley	19.5	36.3
All hay and forage	658.8	923.8
Cropland pastures	1,209.2	1,672.7
Permanent pasture & range	3,268.1	2,726.7
Woodland grazed	6,974.4	5,265.6
Total	12,307.7	10,822.0
Not harvested: idle, fallow, etc.	279.5	194.2
Grand Total	13,107.3	11,755.1

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Feed crops, including hay and pasture, will undergo major variations from the projected trends of feed crop production to satisfy 1980 requirements (table 67). An additional 36,000 acres of feed grains, largely grain sorghums and barley, are necessary. Also, the production of hay and forage crops will require an additional 265,000 acres at yields attainable through technological improvement and resource development.

Capability Classes II and III lands presently in grass and pasture may be converted to more intensive farming with the application of complete water management systems. Floodplain land that is presently being used below capacity, because of the high flood risk, will be farmed more intensively. With flood control structures operating in conjunction with applied land treatment and water management practices, yields are expected to increase and total production will be greater.

In addition to cropland, approximately 10,032,100 acres of permanent pasture and range, including cropland pastured and woodland grazed, should be available for producing 14,806.4 million feed units. It is estimated that 1980 production with proposed programs to satisfy food and fiber requirements will provide about 96 percent of projected feed unit needs. Additional feed units from pasture and grazing may be available in this 10- to 15-year period, if timber clearing in the Southern Mississippi Valley Alluvium and Texas Blackland Prairie continues until maximum clearing operations are achieved. However, to make up the deficit, additional feed units will be realized from grains and hay crops imported from other regions as they meet their share of National Requirements.

By 1980, it is estimated that about 92 percent of the total land area will be classified as inventory land. Within commuting distance of Shreveport, Alexandria, and Texarkana, some cropland and pasture will be intermingled with small farms used as suburban residences. The crop and livestock production will mostly come from commercial family farms. The size of farm units will increase where necessary to maintain an efficient unit under intensive farming operations.

Economic

The installation of the proposed plan for development of land and water resources will result in an increase in crop production and of livestock and livestock products. The increased demands for food by the population, along with improved technology, flood protection for the floodplains, land treatment and water management for soils subject to erosion, and water available for irrigation as needed, will cause rapid changes in the agricultural economy in future years. Operation and maintenance of the 453 potentially feasible upstream reservoirs in the 10- to 15-year category will provide employment for an estimated 130 people annually. Upstream watershed projects also include 1,484 miles of channel improvement. Twenty-three multiple-purpose reservoirs with recreation storage as a purpose will provide 834,200 estimated days of recreation use.

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Improved use of the agriculture resource base should occur with proposed programs. The accelerated development of land and water resources will bring about a change in the volume of goods and services produced. With growing demand, farm value of agricultural production rises. Values are added, usually off of the farm, through the handling, packing, shipping, and processing of raw materials. Increases in net agricultural income are reflected in producers' consumption expenditures or capital accumulation. Expenditures for farm inputs such as hired labor, fertilizer, machinery, gasoline, oil, insecticides, etc., create jobs, payrolls, business profits, and add to the level of economic activity.

The gross value of major crop production during the base year was estimated at $86.3 million. Values fluctuate considerably from year to year as yields and prices of some crops, especially vegetables, are sensitive to supply. Therefore, all prices were converted to current normalized prices.

Assuming an acceleration in the rate of resource development during the projected period, the gross value of crop production by 1980 is expected to increase nearly one-fourth, to an estimated $115.7 million (table 68). Gross value of crop production is projected to be $1,709 per farm in 1980 without project development. With project development, a value of $2,151 is expected. The growth of agriculture during this period results largely from expanding production of soybeans, wheat, grain sorghum, alfalfa and other hay crops, and vegetables. Among the cultivated crops, soybean production is expected to increase 300 percent over the normal trend. Cotton production has been declining in the Study Area, and it can decrease about 38 percent from the projected 1980 trend and still satisfy requirements.

Table 68 - Current Normalized Value of Production of Major Crops, Red River Basin Study Area, 1962 and 1980

Crop or crop group	1962	1980 1/
	- - - - thousand dollars - - -	
Non-Feed Crops		
Wheat	2,448	7,179
Cotton (seed & lint)	45,609	24,622
Sweet potatoes	6,082	11,725
Non-citrus fruits	915	1,118
Vegetables	3,605	5,767
Peanuts	2,311	4,324
Soybeans	1,598	13,052
Miscellaneous	1,369	1,422
Total	63,937	69,209
Feed crops and hay		
Feed grains	8,091	8,609
Alfalfa	2,525	7,635
Other hay	11,737	30,199
Total	22,353	46,443
Grand Total	86,290	115,652

1/ With an acceleration in the rate of resources development, or "with project", as proposed by the SCS and USAE

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The rapidly increasing population with rising incomes demands an ever increasing amount of livestock products. From the increased production of grains, pasture, and hay, farmers can increase their production of livestock. The total income by 1980 from livestock and livestock products with an acceleration in the rate of resource development is estimated to be $341.2 million (current normalized prices), or an increase of approximately $176.5 million over 1962.

The net effect of resource development will be an increased orientation of agriculture towards requirements of population for foods and fiber, including milk, eggs, poultry, beef, and feed to satisfy feed unit requirements. Production of most of these agricultural products is responsive to rising National population and demand.

Major cash inputs in agricultural production are projected to increase 44 percent above 1962 levels by 1980. Changes in labor inputs can be related closely to local employment opportunities. For example, there is a decreasing trend in farm labor costs of 30 percent, or $7.8 million between 1962 and 1980. This would be equivalent to nearly 2,170 jobs at $3,600 annual earnings. It is impossible to determine the net effect that proposed projects will have on farm labor as a result of projects and proposed programs. However, the trend substantiates the decline in farm labor resulting from larger and more efficient farm units.

As has been indicated, the composition of agricultural production is expected to change with greater expansion in soybeans, feed crops and hay, and livestock industries than in cotton and some field crops. These changes in the production mix result in some shift in the character of inputs. Feed costs remain the largest items, and increase greatly in absolute and relative importance. The purchase of livestock and poultry decreases in relative importance, thus emphasizing the expanding cattle feeding industry developing in the Mid-South. To the extent that agriculture can provide feed and livestock for purchase within the industry, it has an opportunity to become less dependent upon nonfarm segments of the economy for required inputs.

As population continues to increase, so will the number of people employed. The trend of decreasing employment in agriculture and increasing employment in nonagriculture will continue. This will be especially significant in the areas around the three largest cities.

The increase in the total number of people employed raises the total income for the Study Area. Much of the increase in employment will occur as a result of project implementation, of increased economic activity, and of people visiting the area to participate in water-oriented outdoor recreation.

Continuing changes in the agricultural economy after the 10- to 15-year project period can be expected. Improvements resulting from long-range project implementation will continue to increase farm income and reduce costs of production while recreational use of lands will continue to contribute additional income for many farm owners and operators.

IMPACTS ON FORESTRY PRODUCTION

Conversion Since 1962

Considerable reservoir construction had been authorized for the USAE by 1962, but no installation had been completed. Completion of these projects will remove directly from production some 155,300 acres of commercial forest lands. The flood protection below these authorized reservoirs is expected to remove from production an additional 53,100 acres of forest land. These lands would be converted to pasture and croplands, according to project estimates.

Reservoir projects proposed by USAE and TWDB for the Study Area will remove an estimated 97,100 acres of commercial forest land from production. Fifteen to 20 percent of this loss is expected from conversion to open land, as a result of flood protection below reservoirs. These changes in land use are attributable to early-action proposals. Additional such developments are proposed before 2010.

Studies of the Red River Navigation and Bank Stabilization project proposed for the Study Area by the USAE, show the project would result in the conversion of some 61,000 acres of bottomland hardwood forest to pasture or cropland.

USDA projects authorized at the time of this report (1967) will remove approximately 15,000 acres of commercial forest land as a result of clearing and conversion to water storage.

USDA projects proposed in the Study Report will remove from production an additional 40 to 45 thousand acres of commercial forest land. Some 32 to 33 thousand acres of this area will be bottomland hardwood forest on the principal alluvial areas.

Multiple-Use Public Forest Lands

Public forest lands are involved on three P. L. 566 watersheds already authorized (by June 30, 1967), with construction after December 31, 1962. Table 69 gives the project name, location by state, and the size and ownership of the public lands.

Table 69 - Public Forest Lands Involved on Authorized 1/ P. L. 566 Projects, Red River Basin Study Area

State and Watershed	CNI Number	Total Area	Public Ownership	Responsible Agency
		acres	acres	
Louisiana				
Bayou Rapides	3-68 & 10-17	96,970	5,000	National Forest
Bayou Bouef	10-15	64,406 2/	2,165 2/	National Forest
Oklahoma				
Waterfall-Gilford	3-40	43,410	960	National Forest

1/ As of June 30, 1967
2/ Acreage in the Study Area

Some upstream watershed projects proposed in this Study involve public forest lands. Table 70 lists the pertinent data for these projects.

Table 70 - Public Forest Lands Involved on Proposed 1/ Upstream Watershed Projects, Red River Basin Study Area

State and Watershed	CNI Number	Total Area	Public Ownership	Responsible Agency
		acres	acres	
Louisiana				
Bayou Rigolette	3-70	247,200	50,900*	National Forest
Bayou Pierre-Cane River	3-66	101,240	16,500*	National Forest
			80,000	National Forest
Kisatchie Bayou-Cane River	3-65	247,908	14,800	Army Training Command
Provencal Creek, Youngs Bayou, & Cane River	3-64	107,070	100	National Forest
Oklahoma				
Norwood Creek	3-40	55,290	1,170	National Forest
Walnut Bayou	3-41	46,210	12,370*	National Forest
Texas				
Barkman Creek	3-48	44,030	2,000	Army Material Command
Lower Bois d'Arc Creek	3-25	133,350	13,000*	National Grasslands
Upper North Sulphur River	3k-14	204,600	1,980	National Grasslands
Middle Sulphur River	3k-17	135,040	700*	National Grasslands

1/ Not authorized by June 30, 1967. Proposed for 10-15 year development

* Structural measures proposed on public lands

The Kisatchie Bayou reservoir project proposed by the USAE in Louisiana will inundate some 4,000 acres of public forest lands. This project is proposed for development within 15 years. National Forest lands in the permanent pool, as well as additional National Forests lands occupied intermittently by flood storage, include hardwood areas that provide superior habitat for several game species and other wildlife. Hardwood stands managed for timber production occupy some of the area.

Public lands such as those of the National Forest system practice multiple-use management to produce a wide range of products and services for many different private users. These products and services are utilized on an area, State, and regional basis. Watershed and water management proposals that impact on these lands must be examined for compatibility with the multiple-use plans that are formulated to provide these products and services. Project proposals in all cases should be acceptable to the overall plan for National Forest use and development.

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Summary

On the Study Area and base area, forest industry wood supply needs by 1980 are expected to approximate the available growth on the 1962 acreage, at 1962 levels of management. A substantial share of the excess growth available at the 1962 level of utilization has been appropriated (1967) by new industry and substantial demands will be added by large plants to be completed in 1968-70.

Some 221,600 acres of commercial forest land will be removed from production by authorized USAE and USDA projects. Loss of another 203,100 acres is expected as a result of proposed projects. All project conversion since 1962 will reduce commercial forest acreage by four to five percent. Some curtailment of present manufacturing activity and employment may occur as a result, or plans for future expansion in some forest industry may be affected.

Losses of hardwood supplies from the expected conversion with project cannot be alleviated on the Study Area, or adjacent supply areas. Employment loss has occurred in hardwood industry of the Study Area. Additional losses can be expected as a result of conversion with project. Expected losses of softwood supplies as a result of authorized and proposed projects can be recovered by reasonable advances in high-level forest management, on lands now in low production.

EFFECTS ON WATER YIELDS

The SCS made estimates of the effects of the potential agricultural program on tributary annual water yield. Calculations were made at stream gage locations near the mouths of several tributary streams. At each gage location, potential upstream watershed development for the tributary basin was assumed in place. The method employed considered the effects of land treatment, stock ponds, and permanent pools of upstream reservoirs. Also, it considered net accretion to base flow at the gage.

Results of the studies show that the aggregate effect of these programs reduce the annual yield at the gage locations approximately four to five percent during years of normal precipitation. The reductions are slightly higher during drouth years--approximately six to seven percent; and slightly lower during wet years--approximately two to three percent. These results should be regarded as approximations only. The net effect could be within the error of measuring water yield from the gaged areas.

Experimental research data from small watershed plots show that a sound program of conservation farming increases infiltration rates. The same is true for large watersheds. However, in very large areas, compensating changes in land treatment practices are likely to occur. Also, in some cases, it is apparent that water which enters the soil as infiltration will appear later as surface runoff at some downstream point.

Gross annual lake surface evaporation losses range from 56 inches in the upper part of the Study Area to 49 inches in the lower part; reservoir net evaporation losses range from about 30 inches to about 6 inches. Losses would come mainly from floodwater detention reservoir permanent pools and from farm pond pools.

Reservoir seepage is not expected to produce any significant changes in tributary water yield. Usually, the construction procedures used to build reservoirs are designed to minimize seepage losses.

RED RIVER MAIN STEM DOWNSTREAM EFFECTS

Upstream watershed reservoir control of the Red River drainage area below Denison Dam ranges from near 40 percent at the mouth of Bois d'Arc Creek, Texas, to near 25 percent near Index, Arkansas. Below Index, reservoir control diminishes rapidly to near 12 percent at Shreveport, Louisiana. It remains about 12 percent at Alexandria, Louisiana. Because of the high percent control above Index, Arkansas, the program could be expected to modify stages along Red River for some storms.

The net effect of the upstream watershed program considers the USAE authorized system of reservoirs in place. At present, the USAE authorized system consists of Denison, Hugo, Boswell, Pat Mayse, and Big Pine reservoirs. Excluding the drainage area above Denison Dam, the system of four reservoirs controls 51 percent of the remaining drainage area above the Index gage. For the storms studied, the USAE authorized system reduced peak flows to approximate bankfull stages at several evaluation points. The completeness of the USAE authorized system of control tends to minimize the beneficial effects of the upstream watershed program.

The Tulsa District Corps of Engineers office cooperated with the SCS in determining the upstream watershed program net effects on Red River stages above Index, Arkansas. Time limitations did not permit an intensive, detailed evaluation of all storms.

The storms of 1938, 1945, and 1957 produced major flooding along Red River. The USAE has used these storms in other studies within the Lower Red River Basin and has developed data related to these events. For these reasons, hydrographs for storms of 1938, 1945, and 1957 were used in making an analysis.

The SCS prepared for these storms, hold-out hydrographs at the mouths of Blue River, Oklahoma, and Bois d'Arc Creek, Texas. The hold-out hydrographs represented the effect of the SCS tributary programs. The USAE routed these storm hydrographs down Red River to determine stage effects at key gage locations. The results of the routings were used for estimating the stage effect of the total upstream watershed program.

Results of the routings show a beneficial stage reduction for the 1938 storm only. The timing and distribution of storm rainfall in 1945

and 1957, coupled with the USAE system of reservoir control, preclude any beneficial stage changes for these events. Probably, the total upstream watershed program would not effect significant stage changes for these events.

For the 1938 flood, the routings indicated three-tenths of a foot net stage reduction at the Arthur City gage; one-tenth of a foot at the Index gage; and one-tenth of a foot at the Fulton gage. With the total upstream watershed program in place, reduction estimates are three-tenths of a foot at the Arthur City gage; two-tenths of a foot at the Index gage; and two-tenths of a foot at the Fulton gage. At the Arthur City gage, note that additional reductions are not attainable because the flow is within bankfull capacity. It is apparent from the hold-out routings that the aggregate upstream watershed program will have beneficial effects on some, but not all, future storms.

The Tulsa District, USAE, furnished information that the SCS used to evaluate the stage effects in monetary terms. The evaluations are considered preliminary since many of the procedures used in arriving at the results are lacking in detail. However, the evaluation results should suffice for basin planning purposes.

Considering the USAE authorized system in place, the average annual flood losses above the Fulton gage are approximately $203,000. Residual losses occur mainly along that part of the river from the mouth of Blue River to the Index gage. In developing an estimate of total annual benefits expected to accrue to the upstream watershed program, a net stage reduction of two-tenths of a foot was assumed for the range of storm frequencies that produced over-bank flow. Correspondingly, average annual losses prevented above the Fulton gage amount to approximately $15,000. Allowing approximately $29,000 for land enhancement and future development, the total annual benefits amount to approximately $44,000. These benefits amount to about seven cents per acre-foot of detention storage assuming 660,000 acre-feet of detention storage in the potential upstream reservoir system.

According to data presented in the USAE survey report "Boswell Reservoir, Boggy Creek, Oklahoma", the flood losses prevented above the Fulton gage for the 1938 storm amount to approximately $25,000 per tenth of a foot net stage reduction at the Fulton gage. Using this relationship as a basis for estimate, the flood losses prevented by the aggregate upstream watershed program for this storm are approximately $50,000.

Information furnished by these investigations provides a basis for assuming that, for most storms, the upstream watershed program will not produce significant stage changes on Red River below the Fulton gage.

IMPACT ON SOIL CONSERVATION AND LAND TREATMENT REQUIREMENTS

Projected land use trends and water and related land resources development will affect land treatment requirements. Amounts and types of conservation practices will be affected. Changes after the 1962 base

period will result from decreases in total land area and Inventory acreage and from major land use changes on the projected Inventory acreage.

Parts of the agricultural land resource base will be converted to water area and to urban and built-up area. A tabulation of these changes (from tables 2, 3, and 66) for the base period and 1980 projections without project development follows:

Item	1962	1980	Projected Changes to 1980
	- - - - - thousand acres - - - - -		
Large water area	289.3	333.6	+ 44.3
Land area	18,661.0	18,616.7	- 44.3
Inventory area	17,333.3	17,249.8	- 83.5
Non-Inventory	1,327.7	1,366.9	+ 39.2
Total Study Area	18,950.3	18,950.3	0

These data show that the land treatment requirements will decrease by 44,300 acres. Another 39,200 acres shift into urban and built-up area and will no longer require application of agricultural and forestry conservation practices.

Major land use changes will be produced with project development. These are summarized in Table 71 by land resource areas.

Project development will increase cropland acreage in each land resource area. Pasture and range acreages will decrease in all land resource areas except in the Southern Mississippi Valley Alluvium and Silty Uplands Land Resource Areas, which increase about 14 percent. Forest and woodland acreages decrease in all resource areas.

The data indicate the direction of changes that will be required in total amounts of conservation practices for the major land uses. On-farm drainage can be expected to increase substantially in the Southern Mississippi Valley Alluvium to stay in pace with project development. Irrigation conservation practices in Louisiana will need to be developed concurrently with structural features of watershed projects.

Watershed protection is a major purpose of all potential upstream watershed projects. An effective conservation program, based upon the use of each acre of land within its capabilities and upon its treatment in accordance with its needs for protection and improvement, is necessary for sound watershed protection and structural programs in potential watershed projects. Establishment and maintenance of all applicable soil and water conservation and plant management practices essential to proper land use are basic to watershed project development.

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Table 71 - Major Land Use Changes with Project Development by Land Resource Areas, Red River Basin Study Area

Land Resource Area and Major Land Use	1980 Without Project Development 1/	1980 With Project Development 2/	Changes With Project Development
	- - - - - - - - - thousand acres - - - - - - - - -		
Texas Blackland Prairie (86)			
Cropland	831.2	1,174.5	+ 343.3
Pasture-Range	653.4	305.5	- 347.9
Forest-Woodland	261.7	201.9	- 59.8
Other Land	30.9	32.4	+ 1.5
Subtotal	1,777.2	1,714.3	- 62.9
Southern Mississippi Valley Alluvium and Silty Uplands (131,134)			
Cropland	622.6	892.4	+ 269.8
Pasture-Range	640.6	685.2	+ 44.6
Forest-Woodland	1,173.6	815.0	- 358.6
Other Land	63.3	76.0	+ 12.7
Subtotal	2,500.1	2,468.6	- 31.5
Grand Prairie and Cherokee Prairies (85,112)			
Cropland	201.7	271.7	+ 70.0
Pasture-Range	598.2	558.3	- 39.9
Forest-Woodland	239.3	200.0	- 39.3
Other Land	100.4	105.4	+ 5.0
Subtotal	1,139.6	1,135.4	- 4.2
Central Rolling Red Prairies, Cross Timbers, and Southern Coastal Plain (80, 84, 84a, 133)			
Cropland	1,162.1	1,367.8	+ 205.7
Pasture-Range	1,227.0	1,024.5	- 202.5
Forest-Woodland	6,529.3	6,096.6	- 432.7
Other Land	203.8	264.9	+ 61.1
Subtotal	9,122.2	8,753.8	- 368.4
Ouachita Mountains (119)			
Cropland	47.2	56.3	+ 9.1
Pasture-Range	148.9	153.2	+ 4.3
Forest-Woodland	2,500.0	2,481.4	- 18.6
Other Land	14.6	19.0	+ 4.4
Subtotal	2,710.7	2,709.9	- 0.8
Entire Study Area			
Cropland	2,864.8	3,762.7	+ 897.9
Pasture-Range	3,268.1	2,726.7	- 541.4
Forest-Woodland	10,703.9	9,788.9	- 915.0
Other Land	413.0	497.7	+ 84.7
Total	17,249.8	16,776.0	- 473.8

1/ From Exhibit 5
2/ From Exhibit 37

Treatment on drainage areas above structural improvements is necessary to reduce the rate of deterioration in the uplands and to prevent excessive sediment accumulation in reservoirs and channels. Land treatment measures will reduce soil erosion, sediment production, and storm runoff by improving the soil-water relationship. Land treatment measures on drainage areas that do not discharge runoff

through structural improvements will serve to reduce floodwater and sediment damage to floodplain lands.

Potential project development would require special emphasis on the establishment of those land treatment practices that have a measurable effect on reduction of floodwater and sediment damages and on costs of providing sediment storage capacity in reservoirs. Acceleration of land treatment establishment would be required in potential project areas.

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USDA WATER AND RELATED LAND RESOURCE PROJECTS AND MEASURES RECOMMENDED FOR EARLY ACTION

EARLY-ACTION PROGRAM

USDA investigations show that projects and measures included for early action are feasible and are urgently needed to solve watershed problems and meet estimated needs through 1980. All projects have been coordinated with interested agencies and some projects are interrelated with project development proposed by other agencies.

Watersheds listed for early action have acute problems that can be solved under the USDA upstream watershed program. Problems include floodwater, sediment, erosion, inadequate drainage, pollution, drought, water supply, and recreation. In addition to solving problems within the watershed, the early-action watershed program can help alleviate related problems that occur outside the watershed areas and contribute to meeting estimated needs within the basin. Single-purpose projects also are needed to meet acute shortages. These would include reservoirs for recreational development and municipal and industrial water supplies.

The USAE proposed reservoir projects in some watersheds in which USDA projects have been proposed. These include Bonham, Durant, Parker, and Kisatchie Reservoirs in CNI Watersheds 3-25a, 3-23, 3h2-4, and 3-64. USDA developed alternate plans for these watersheds to accommodate USAE proposals. All of the projects will be considered by the Plan Formulation Task Force in basin plan development. Projects selected for the basin plan will be shown in the Plan Formulation Appendix.

Multiple-Purpose Projects

Watershed Improvements

Multiple-purpose watershed project plans were formulated for all CNI watersheds that urgently need development within the next 10-15 years. The installation of reservoirs, channel improvement, sediment control structures, erosion control, and water control structures would provide direct flood prevention, erosion control, and drainage improvements benefits along the floodplains of the watersheds. These structural improvements would provide protection that cannot be attained by land treatment measures alone. Selected reservoir sites could be developed for multiple-purpose use by including storage for water supply, recreation, water quality control, and irrigation purposes.

Approximately 6,967 square miles, or about 24 percent of the Study Area, are included in the CNI watersheds recommended for early action. Watershed locations are shown in Figure 13. Structural measures that could be installed include 459 floodwater retarding and multiple-purpose reservoirs, 15 water control structures, seven erosion control structures, one sediment control structure, and 1,479 miles of flood prevention, drainage, and irrigation channels. Pertinent structural data are summarized in Table 72.

Table 72 - Pertinent Structural Data - Multiple-Purpose Projects for Early Action, Red River Basin Study Area

Tributary: Basin and: CNI Watershed	Planning Status [1]	Water-shed Area	Drainage Area Controlled	Structural Measures: Reservoirs	Structural Measures: Other [2]	Channel Improvement	Pool Capacity: Detention	Pool Capacity: Sediment	Pool Capacity: Other [3]	Surface Area of Permanent Pool [4]	Additional Reservoir Storage Available
		(sq.mi.)	(sq.mi.)	number	number	miles	(ac.ft.)	(ac.ft.)	(ac.ft.)	acres	(ac.ft.)
Intervening Areas - Texas											
3-19	A	262.5	112.6	41	7 EC	25.0	43,106	11,699	2,990 R 24,127 M 101 I	2,508	0
3-25	C	208.4	102.0	20	0	22.0	34,420	9,760	0	1,505	58,180
3-25a	C	222.6	94.8	21	0	8.0	35,710	8,620	1,580 R 5,750 W 10,400 M	2,280	43,700
3-27	A	11.5	4.0	3	0	12.1	1,336	303	0	61	0
3-29	C	22.8	1.5	2	1 SC	28.6	490	140	480 R	98	0
3-33	A	186.0	84.0	19	0	19.5	31,793	4,380	0	670	0
Total		913.8	398.9	106	8	115.2	146,855	34,902	45,428	7,122	101,880
Intervening Areas - Arkansas and Oklahoma											
3-35	D	26.0	12.0	1	0	8.5	4,925	576	394 R	65	5,770
3-39	A	67.8	18.4	12	0	68.0	4,537	702	0	167	0
3-40	D	86.4	28.0	3	0	21.2	8,634	1,350	0	164	10,460
3-41	C	89.8	32.0	11	0	27.0	10,940	1,950	450 R	463	30,140
3-46	A	24.0	8.4	2	0	16.6	3,080	293	0	71	NA
Total		294.0	98.8	29	0	141.3	32,116	4,871	844	930	46,370
Blue River											
3-23	C	360.4	167.3	30	0	0	66,510	13,570	1,000 F 2,000 R 8,060 M 2,050 W	2,520	48,680
Total		360.4	167.3	30	0	0	66,510	13,570	13,110	2,520	48,680
Boggy Creek											
3h1-2	A	375.5	161.8	37	0	2.0	43,811	6,957	0	1,302	NA
3h1-3	A	47.7	32.2	14	0	0	8,865	1,423	0	286	NA
3h2-4	D	225.4	155.0	25	0	0	49,250	8,250	2,000 M	NA	NA
3h2-6	B, D	322.2	199.0	55	0	0	63,500	10,600	2,000 M 1,000 R	NA NA	NA NA
Total		970.8	548.0	131	0	2.0	165,426	27,230	5,000	1,588	NA
Kiamichi River											
3i-2	A	14.3	2.0	2	0	12.0	609	103	0	24	0
3i-4	B	62.0	37.8	10	0	8.5	12,288	2,142	1,350 R 3,000 M	873 0	0
3i-8	A	59.4	24.9	4	0	0	9,285	1,083	2,600 M	70	NA
Total		135.7	64.7	16	0	20.5	22,182	3,328	6,950	967	NA
Barkman Creek											
3-47	C	4.0	-	-	-	4.0	-	-	-	-	-
3-48	C	69.0	-	-	-	19.0	-	-	-	-	-
Total		73.0	-	-	-	23.0	-	-	-	-	-
Little River											
3j-4	C	147.0	47.4	14	0	0	21,120	3,390	320 R	580	30,790
Total		147.0	47.4	14	0	0	21,120	3,390	320	580	30,790
McKinney Bayou											
3-52	C	195.8	31.0	4	0	78.0	14,870	800	1,410 R	408	13,740
3-53	C	86.3	-	-	-	71.0	-	-	-	-	-
3-54	C	45.1	-	-	-	33.0	-	-	-	-	-
Total		327.2	31.0	4	0	182.0	14,870	800	1,410	408	13,740
Sulphur River											
3k-9	D	98.0	46.0	7	0	0	18,320	7,624	0	610	0
3k-11	D	6.0	5.0	1	0	0	3,065	540	324 R 354 M	240	0
3k-12	C	30.0	11.3	3	0	0	4,870	970		154	3,480
3k-14	C	319.7	12.7	1	0	0	5,690	1,860	1,250 R	306	0
3k-17	C	211.0	49.2	21	0	16.0	17,280	4,090	0	880	5,710
3k-18	C	121.0	61.0	23	0	0	21,140	5,950	700 W	1,190	10,010
Total		785.7	185.2	56	0	16.0	70,365	21,034	2,628	3,380	19,200

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Continued ---

Table 72 - Pertinent Structural Data - Multiple-Purpose Projects for Early Action, Red River Basin Study Area -- Continued

Tributary Basin and: CNI Watershed	Planning Status [1]	Water-shed Area	Drainage Area Controlled	Structural Measures: Reservoirs	Structural Measures: Other [2]	Channel Improvement	Pool Capacity: Detention	Pool Capacity: Sediment	Pool Capacity: Other [3]	Surface Area of Permanent Pool [4]	Additional Reservoir Storage Available
		(sq.mi.)	(sq.mi.)	number	number	miles	- - - (ac.ft.) - - -			acres	(ac.ft.)
Posten Bayou											
3-57	C	95.8	0	1	0	39.2	0	130	500 R	120	0
Total		95.8	0	1	0	39.2	0	130	500 R	120	0
Red River Main Stem											
3-60	D	37.6	-	-	-	9.0	-	-	-	-	-
Total		37.6	-	-	-	9.0	-	-	-	-	-
Loggy Bayou											
3m-1	A	13.4	3.8	1	0	3.0	1,175	98	0	20	NA
3m1-7	C	140.2	54.4	9	0	21.8	25,010	1,090	820 R 20,300 M 6,000 W	2,813	5,300
3m2-3	A	232.0	-	2	11 WC	55.0 [5]	0	1,590	6,010 R 19,650 I 4,350 M	3,850	NA
Total		385.6	58.2	12	11 WC	79.8	26,185	2,778	57,130	6,683	5,300
Bayou Pierre											
3n-2	C	144.1	63.9	9	0	12.0 [5]	27,450	2,080	5,100 I 7,540 R	2,659	52,810
Total		144.1	63.9	9	0	12.0	27,450	2,080	12,640	2,659	52,810
Cane River											
3-64	D	162.8	89.9	10	0	10.0	32,471	4,372	52,560 M	4,070	NA
3-65	D	378.3	257.0	23	0	5.0 [5]	103,933	12,244	807 R 49,278 I	4,691	NA
3-66	D	161.7	63.9	5	0	45.0	23,461	2,820	902 R	291	NA
Total		702.8	410.8	38	0	60.0	159,865	19,436	103,547	9,052	NA
Bayou Rigolette											
3-69	C	31.5	-	-	-	18.0	-	-	-	-	-
3-70	C	386.2	116.8	11	0	63.0	54,940	3,440	3,200 R	986	105,950
Total		417.7	116.8	11	0	81.0	54,940	3,440	3,200	986	105,950
Red River Backwater											
3-73	D	60.8	-	-	-	29.0	-	-	-	-	-
3-75	D	173.5	-	-	-	70.0	-	-	-	-	-
3-76	D	37.0	-	-	-	28.0	-	-	-	-	-
Total		271.3	-	-	-	127.0	-	-	-	-	-
Chatlin Lake & Associated Area											
10-10	B, D	169.3	-	-	-	80.0	-	-	-	-	-
10-11 & 10-12	A	103.4	-	-	-	83.0	-	-	-	-	-
10-13 & 10-14	B, D	375.8	-	-	-	249.0	-	-	-	-	-
10-15	A	184.		2	4 WC	24.4 [5]	-	1,450	10,860 R 37,690 I	4,170	-
10-16	B, D	71.6	-	-	-	135.0	-	-	-	-	-
Total		904.6	-	2	4 WC	571.4	-	1,450	48,550	4,170	-
Grand Total		6,967.1	2,191.0	459	23	1,479.4	807,884	138,439	301,257	41,165	424,720

1/ Abbreviations: A- Watershed approved for operation; B - Workplan investigations underway; C - River Basin watershed investigation report completed; D - Field examination scope study completed

2/ Abbreviations for other structures: EC - Erosion Control; SC - Sediment Control; WC - Water Control

3/ Abbreviations for other pool capacities: R - Recreation; M - Municipal; I - Irrigation; W - Water Quality Control; F - Fish and Wildlife

4/ Total surface area at principal spillway elevation

5/ Multiple-Purpose channel - Irrigation and drainage

Tabulated structural data were derived from watershed work plans, river basin investigation reports, and field examination scope studies. Data included in watershed work plans were developed from detail field

survey and design by the respective states. Investigation report data were developed using field survey data, quadrangle data, and other available data. Field examination scope studies data were developed from quadrangle maps and curves of structural measures in similar land resource areas. The intensity of studies for each watershed is shown under planning status in Table 72.

Potential storage of the floodwater retarding and multiple-purpose reservoirs is approximately 1,247,580 acre-feet divided as follows: 138,439 acre-feet for sediment accumulation, 44,187 acre-feet for recreation, 129,751 acre-feet for municipal and industrial water supply, 111,819 acre-feet for irrigation, 14,500 acre-feet for water quality control, 1,000 acre-feet for fish and wildlife, and 807,884 acre-feet for flood detention. Multiple-purpose reservoir storage was allocated to purposes based on water resource development needs in each watershed.

Channel improvement provides adequate outlets for floodwater retarding structure releases and on-farm drainage systems. Approximately 96 miles of multiple-purpose channel could provide a delivery system and drainage outlets for irrigation water.

The upstream watershed program offers excellent opportunities for developing recreation resources by including recreation water storage in favorably located multiple-purpose reservoirs. Recreation facilities for picnicking, boating, fishing, camping, and swimming could be included in conjunction with reservoir site development.

Based on physical characteristics of the sites and water yield, an additional 424,720 acre-feet of storage is available in some of the 459 reservoir sites. Additional potential storage was computed only for watersheds where basin investigation reports were made. Data were not available for determining the additional storage potential in areas with watershed work plans and field examination scope studies. A dependable runoff yield and physical limitation of the sites related to topography and cultural development were the criteria used in determining additional storage possibilities. Sediment and flood detention requirements were not considered a part of the additional storage.

Installation Costs

The structural installation costs data were tabulated from watershed work plans and from watershed investigation reports. Field examination scope study data were used for some watersheds.

Structural costs included in investigation reports were based on unit costs of structural measures in similar areas. Ten percent was added as a contingency to provide funds for unpredictable construction costs. Unit costs were modified to reflect special conditions for establishing protective vegetation and size of principal spillway. Estimated values of land required for rights-of-way were based on appraisals made by local landowners and SCS personnel. Costs of legal fees, administration of contracts, and installation services that

include engineering and administrative costs are based on SCS experience for similar works.

Structural costs included in field examination scope studies were estimated based on data developed for structural measures in similar areas.

Prices current at the time of project planning were used for estimating installion costs. These range from 1961 to 1967.

The estimated installation cost of the potential projects is $108,643,510. Of this amount, $70,491,280 would be expended for construction, $19,910,620 for installation services; $17,239,470 for land, easements, and rights-of-way, and $502,140 for administration of contracts. The estimated structural installation costs are summarized for individual watershed projects in Table 73.

Allocation of Cost and Cost Sharing

Structural installation costs were allocated to purposes proportionately to the use of facilities. In all multiple-purpose reservoirs that include floodwater retardation storage, costs for sediment storage were allocated to the flood prevention purpose. Total installation costs are $108,643,510. Of these costs, about $74,323,567 would be borne by Federal funds and the remaining $34,319,943 would be provided by non-Federal funds. Cost allocation and cost sharing for watershed projects is shown in Table 74.

Project Benefits

Benefits from structural measures total $12,216,205 annually. Reduction of damages amounting to $4,494,275 comprises the major item of benefits. Benefits of $1,430,460 annually are expected from more intensive and changed land use. Additional Red River main stem benefits above Fulton, Arkansas, estimated at $29,150 annually, will accrue from structural measures in watersheds above Fulton. There are also damage reduction benefits estimated at $178,710 annually from land treatment measures in these watersheds. Agricultural water management benefits are estimated at $2,247,895 from improved drainage and $797,620 from irrigation. Benefits from nonagricultural water management are estimated at $427,770 for municipal and industrial water supply, $56,000 for water quality control, and $1,247,030 for recreation. Benefits from potential watershed projects are summarized in Table 75.

The amount of municipal and industrial water supply storage, annual benefits, and benefited communities are summarized by CNI watersheds in Exhibit 38. Water quality storage, pollution source, and annual benefits are summarized by watersheds in Exhibit 39. Recreation benefits from multiple-purpose reservoirs and incidental recreation from sediment pools of flood prevention reservoirs are valued at $1,247,090 annually from an estimated 885,900 visitor-days of recreation use. These are summarized by CNI watersheds in Exhibit 40.

Table 73 - Estimated Structural Installation Cost - Multiple-Purpose Projects for Early Action, Red River Basin Study Area

Tributary Basin and CNI watershed	Planning Status 1/	Construction: Floodwater-Retarding Structures	Multiple-Purpose Structures	Other 2/ Structures	Channel Improvement	Basic Facilities	Subtotal	Installation Services	Land, Easements, and Rights-of Way	Administration of Contracts	Total	Price Base
						dollars						year
Intervening Areas - Texas												
3-19	A	2,081,200	2,263,800	165,950 EC	399,300	425,810	5,336,060	1,137,600	2,204,240	39,500	8,717,400	1965
3-25	C	1,277,100	0	0	1,390,400	0	2,667,500	692,000	729,630	12,670	4,101,800	1966
3-25a	C	826,870	729,630	0	356,400	165,000	2,077,900	460,230	848,790	10,380	3,397,300	1966
3-27	A	133,430	0	0	143,440	0	276,870	76,460	63,170	3,500	420,000	1962
3-29	C	24,710	47,950	9,380 SC	123,150	5,000	210,190	54,530	40,880	3,600	309,200	1967
3-33	A	1,269,180	0	0	737,770	0	2,006,950	484,130	558,820	10,000	3,059,900	1962
Total		5,612,490	3,041,380	175,330	3,150,460	595,810	12,575,470	2,904,950	4,445,530	79,650	20,005,600	----
Intervening Areas - Arkansas and Oklahoma												
3-35	D	0	264,300	0	44,570	165,000	473,870	129,240	77,050	2,150	682,310	1965
3-39	A	205,530	0	0	774,180	0	979,710	263,090	474,190	13,420	1,730,410	1961
3-40	D	265,560	0	0	161,150	0	426,710	116,380	64,130	1,940	609,160	1965
3-41	C	593,340	110,660	0	279,300	165,000	1,148,300	310,010	145,300	5,230	1,608,840	1966
3-46	A	202,510	0	0	257,180	0	459,690	124,100	73,830	2,090	659,710	1964
Total		1,266,940	374,960	0	1,516,380	330,000	3,488,280	942,820	834,500	24,830	5,290,430	----
Blue River												
3-23	C	1,964,270	1,121,220	0	0	165,000	3,250,490	871,790	1,486,380	14,670	5,623,330	1966
Total		1,964,270	1,121,220	0	0	165,000	3,250,490	871,790	1,486,380	14,670	5,623,330	----
Boggy Creek												
3h1-2	A	1,649,850	0	0	35,380	0	1,885,230	488,280	347,960	11,100	2,732,570	1961
3h1-3	A	453,460	0	0	0	0	453,460	118,610	60,000	4,200	636,270	1961
3h2-4	D	1,975,000	196,000	0	0	0	2,171,000	507,000	203,000	7,500	2,888,500	1966
3h2-6	B,D	2,870,000	414,630	0	0	165,000	3,449,630	836,150	473,100	17,780	4,776,660	1966
Total		7,148,310	610,630	0	35,380	165,000	7,959,320	1,950,040	1,084,060	40,580	11,034,000	----
Klamichi River												
3i-2	A	73,700	0	0	216,950	0	290,650	78,040	110,260	3,050	482,000	1963
3i-4	B	430,500	259,030	0	221,060	142,060	1,052,650	240,230	239,610	8,280	1,540,770	1963
3i-8	A	882,540	126,050	0	0	0	1,008,590	200,950	20,980	1,600	1,232,120	1962
Total		1,386,740	385,080	0	438,010	142,060	2,351,890	519,220	370,850	12,930	3,254,890	----
Harkman Creek												
3-47	C	0	0	0	34,100	0	34,100	9,210	19,430	160	62,900	1967
3-48	C	0	0	0	224,510	0	224,510	60,590	118,060	1,020	404,180	1967
Total		0	0	0	258,610	0	258,610	69,800	137,490	1,180	467,080	----
Little River												
3j-4	C	1,688,060	314,930	0	0	165,000	2,167,990	585,310	298,760	9,870	3,061,930	1967
Total		1,688,060	314,930	0	0	165,000	2,167,990	585,310	298,760	9,870	3,061,930	----
McKinney Bayou 3/												
3-52	C	245,960	173,690	0	545,820	165,000	1,130,470	305,180	316,550	5,140	1,757,340	1967
3-53	C	0	0	0	626,120	0	626,120	169,030	201,360	2,850	999,360	1967
3-54	C	0	0	0	182,310	0	182,310	49,220	107,360	830	339,720	1967
Total		245,960	173,690	0	1,354,250	165,000	1,938,900	523,430	625,270	8,820	3,096,420	----
Sulphur River												
3k-9	D	561,690	0	0	0	0	561,690	199,140	97,020	2,550	860,400	1965
3k-11	D	0	82,140	0	0	110,000	192,140	31,630	73,500	870	298,140	1965
3k-12	C	196,680	0	0	0	0	196,680	49,260	125,400	980	372,320	1967
3k-14	C	0	309,650	16,720 EC	0	165,000	491,370	96,090	152,300	2,460	742,220	1967
3k-17	C	888,470	0	0	127,160	0	1,015,630	277,760	445,970	5,070	1,744,430	1967
3k-18	C	899,690	90,530	0	0	0	990,220	277,660	546,330	4,970	1,819,180	1967
Total		2,546,530	482,320	16,720	127,160	275,000	3,447,730	931,540	1,440,520	16,900	5,836,690	----
Posten Bayou 3/												
3-57	C	0	0	115,000	617,300	172,000	904,300	242,800	187,200	3,900	1,338,200	1965
Total		0	0	115,000	617,300	172,000	904,300	242,800	187,200	3,900	1,338,200	----
Red River Main Stem												
3-60	D	0	0	0	53,460	0	53,460	16,520	9,480	240	79,700	1966
Total		0	0	0	53,460	0	53,460	16,520	9,480	240	79,700	----
Loggy Bayou												
3n-1	A	68,520	0	0	11,950	0	80,470	27,530	28,400	1,600	138,000	1964
3m1-7	C	748,150	1,735,640	0	398,970	191,810	3,074,570	830,050	690,110	13,970	4,608,700	1967
3n2-3	A	0	3,748,440	320,320 WC	413,190	748,550	5,230,500	1,711,260	1,342,640	100,500	8,384,900	1965
Total		816,670	5,484,080	320,320	874,110	940,360	8,385,540	2,568,840	2,061,150	116,070	13,131,600	----
Bayou Pierre												
3n-2	C	810,700	740,300	0	112,200	165,000	1,828,200	640,680	411,340	8,300	2,888,520	1966
Total		810,700	740,300	0	112,200	165,000	1,828,200	640,680	411,340	8,300	2,888,520	----
Cane River												
3-64	D	303,980	1,819,470	0	110,000	0	2,233,450	791,840	513,600	10,160	3,549,050	1965
3-65	D	1,520,880	3,107,940	0	376,750	330,000	5,335,570	1,876,710	1,104,250	24,250	8,340,780	1965
3-66	D	475,830	286,990	0	321,750	330,000	1,414,570	486,530	278,430	6,430	2,185,960	1965
Total		2,300,690	5,214,400	0	808,500	660,000	8,983,590	3,155,080	1,896,280	40,840	14,075,790	----
Bayou Bigolette 3/												
3-69	C	0	0	0	116,820	0	116,820	36,210	59,200	530	212,760	1966
3-70	C	1,660,010	514,910	0	1,408,330	165,000	3,748,250	1,242,260	744,750	17,020	5,752,280	1966
Total		1,660,010	514,910	0	1,525,150	165,000	3,865,070	1,278,470	803,950	17,550	5,965,040	----
Red River Backwater												
3-73	D	0	0	0	142,660	0	142,660	44,100	25,290	650	212,700	1966
3-75	D	0	0	0	345,400	0	345,400	106,760	61,230	1,570	514,960	1966
3-76	D	0	0	1,207,200 Pump	138,340	0	1,345,540	384,800	24,520	5,660	1,760,520	1966
Total		0	0	1,207,200	626,400	0	1,833,600	535,660	111,040	7,880	2,488,180	----
Chatlin Lake and Associated Areas												
10-10	B,D	0	0	0	200,000	0	200,000	70,910	35,180	910	307,000	1966
10-11 & 10-12	A	0	0	0	766,240	0	766,240	267,030	239,450	20,000	1,292,720	1965
10-13 & 10-14	B,D	0	0	0	1,944,480	0	1,944,480	260,740	176,870	8,840	2,390,930	1966
10-15	A	0	3,138,300	229,090 WC	211,240	290,690	3,869,320	1,265,930	417,210	64,000	5,616,460	1964
10-16	B,D	0	0	0	918,800	0	918,800	309,060	166,960	4,180	1,399,000	1966
Total		0	3,138,300	229,090	4,040,760	290,690	7,698,840	2,173,670	1,035,670	97,930	11,006,110	----
Grand Total		27,447,370	21,596,200	2,063,660	15,488,130	4,395,920	70,991,280	19,910,620	17,239,470	502,140	108,643,510	----

1/ Abbreviations for Planning Status: A - Authorized for operation; B- Workplan investigations underway; C - River Basin watershed investigation report complete; D - Field examination scope studies complete

2/ Abbreviations for Other Structures: EC - Erosion Control; SC - Sediment Control; WC - Water Control

3/ Does not include USAE costs for major outlets

4-4489

Table 74 - Allocation of Costs to Purpose and Cost-Sharing Summary Projects for Early Action, Red River Basin Study Area

Tributary Basin and CNI Watershed	Planning Status 1/	Cost Allocation to Purpose: Flood Prevention	Drainage	Irrigation	Recreation	Municipal and Industrial	Water Quality	Cost-Sharing: Total Installation Costs	Federal Funds	Non-Federal Funds
						dollars				
Intervening Areas - Texas										
3-19	A	5,498,980	7,400	12,740	1,125,090	2,073,190	-	8,717,400	4,812,280	3,905,120
3-25	C	4,101,800	-	-	-	-	-	4,101,800	3,359,500	742,300
3-25a	C	2,609,470	-	-	325,280	287,380	175,170	3,397,300	2,213,230	1,184,070
3-27	A	328,390 2/	91,610	-	-	-	-	420,000	326,050	93,950
3-29	C	158,740	89,040	-	61,420	-	-	309,200	221,875	87,325
3-33	A	3,059,900	-	-	-	-	-	3,059,900	2,491,080	568,820
Total		15,757,280	188,050	12,740	1,511,790	2,360,570	175,170	20,005,600	13,424,015	6,581,585
Intervening Areas - Arkansas and Oklahoma										
3-38	D	386,820	34,790	-	260,700	-	-	682,310	513,500	168,810
3-39	A	1,147,455	582,955	-	-	-	-	1,730,410	1,109,456	620,954
3-40	D	494,095	115,065	-	-	-	-	609,160	502,800	106,360
3-41	C	1,221,780	133,530	-	253,530	-	-	1,608,840	1,305,825	303,015
3-46	A	499,975	159,735	-	-	-	-	659,710	526,044	133,666
Total		3,750,125	1,026,075	-	514,230	-	-	5,290,430	3,957,625	1,332,805
Blue River										
3-23	C	4,391,520	-	-	427,440 3/	710,910	93,460	5,623,330	3,590,650	2,032,680
Total		4,391,520	-	-	427,440	710,910	93,460	5,623,330	3,590,650	2,032,680
Boggy Creek										
3h1-2	A	2,732,570	-	-	-	-	-	2,732,570	2,373,510	359,060
3h1-3	A	636,270	-	-	-	-	-	636,270	572,070	64,200
3h2-4	D	2,727,070	-	-	-	161,430	-	2,888,500	2,536,250	352,250
3h2-6	B,D	4,194,050	-	-	403,430	179,180	-	4,776,660	3,972,460	804,250
Total		10,289,960	-	-	403,430	340,610	-	11,034,000	9,454,250	1,579,710
Kiamichi River										
3i-2	A	391,485	90,515	-	-	-	-	482,000	341,895	140,105
3i-4	B	910,605	-	-	387,630	242,535	-	1,540,770	981,595	559,175
3i-8	A	1,232,120	-	-	-	-	-	1,232,120	1,209,540	22,580
Total		2,534,210	90,515	-	387,630	242,535	-	3,254,890	2,533,030	721,860
Barkman Creek										
3-47	C	32,700	30,200	-	-	-	-	62,900	35,125	27,775
3-48	C	210,580	193,600	-	-	-	-	404,180	231,330	172,850
Total		243,280	223,800	-	-	-	-	467,080	266,455	200,625
Little River										
3j-4	C	2,795,760	-	-	266,170	-	-	3,061,930	2,653,060	408,870
Total		2,795,760	-	-	266,170	-	-	3,061,930	2,653,060	408,870
McKinney Bayou										
3-52	C	1,044,815	447,635	-	264,890	-	-	1,757,340	1,206,685	550,655
3-53	C	499,680	499,680	-	-	-	-	999,360	638,620	360,740
3-54	C	169,860	169,860	-	-	-	-	339,720	185,955	153,765
Total		1,714,355	1,117,175	-	264,890	-	-	3,096,420	2,031,260	1,065,160
Sulphur River										
3k-9	D	860,400	-	-	-	-	-	860,400	760,830	99,570
3k-11	D	111,840	-	-	175,650	10,650	-	298,140	166,750	131,390
3k-12	C	372,320	-	-	-	-	-	372,320	245,940	126,380
3k-14	C	449,660	-	-	292,560	-	-	742,220	541,655	200,565
3k-17	C	1,744,430	-	-	-	-	-	1,744,430	1,293,390	451,040
3k-18	C	1,767,440	-	-	-	-	51,740	1,819,180	1,228,900	590,280
Total		5,306,090	-	-	468,210	10,650	51,740	5,836,690	4,237,465	1,599,225
Posten Bayou										
3-57	C	461,600	461,600	-	415,000	-	-	1,338,200	836,675	501,525
Total		461,600	461,600	-	415,000	-	-	1,338,200	836,675	501,525
Red River Main Stem										
3-60	D	39,850	39,850	-	-	-	-	79,700	56,615	23,085
Total		39,850	39,850	-	-	-	-	79,700	56,615	23,085
Loggy Bayou										
3m-1	A	138,000	-	-	-	-	-	138,000	108,000	30,000
3m1-7	C	2,157,490	-	-	331,410	1,707,720	412,080	4,608,700	2,090,480	2,518,220
3m2-3	A	338,513	207,474	4,772,031	2,155,575	911,307	-	8,384,900	3,912,440	4,472,460
Total		2,634,003	207,474	4,772,031	2,486,985	2,619,027	412,080	13,131,600	6,110,920	7,020,680
Bayou Pierre										
3n-2	C	1,855,215	-	419,465	613,840	-	-	2,888,520	2,214,205	674,315
Total		1,855,215	-	419,465	613,840	-	-	2,888,520	2,214,205	674,315
Cane River										
3-64	D	1,823,410	-	174,000	-	1,551,640	-	3,549,050	1,641,580	1,907,470
3-65	D	5,183,350	-	2,603,050	554,380	-	-	8,340,780	6,237,940	2,102,840
3-66	D	1,082,080	-	508,950	594,930	-	-	2,185,960	1,552,895	633,065
Total		8,088,840	-	3,286,000	1,149,310	1,551,640	-	14,075,790	9,432,415	4,643,375
Bayou Rigolette										
3-69	C	106,380	106,380	-	-	-	-	212,760	123,825	88,935
3-70	C	4,242,190	1,130,990	-	379,100	-	-	5,752,280	4,526,635	1,225,645
Total		4,348,570	1,237,370	-	379,100	-	-	5,965,040	4,650,460	1,314,580
Red River Backwater										
3-73	D	106,350	106,350	-	-	-	-	212,700	151,095	61,605
3-75	D	257,480	257,480	-	-	-	-	514,960	365,810	149,150
3-76	D	880,260	880,260	-	-	-	-	1,760,520	1,393,955	366,565
Total		1,244,090	1,244,090	-	-	-	-	2,488,180	1,910,860	577,320
Chatlin Lake and Associated Areas										
10-10	B,D	153,500	153,500	-	-	-	-	307,000	220,910	86,090
10-11 & 12	A	749,777	542,943	-	-	-	-	1,292,720	872,355	420,365
10-13 & 14	B,D	1,195,465	1,195,465	-	-	-	-	2,390,930	1,719,100	671,830
10-15	A	-	-	4,210,257	1,406,203	-	-	5,616,460	3,153,042	2,463,418
10-16	B,D	699,500	699,500	-	-	-	-	1,399,000	998,160	400,840
Total		2,798,242	2,591,408	4,210,257	1,406,203	-	-	11,006,110	6,963,567	4,042,543
Grand Total		68,252,990	8,427,407	12,700,493	10,694,228	7,835,942	732,450	108,643,510	74,323,567	34,319,943

1/ Abbreviations for Planning Status: A - Authorized for operation; B - Workplan investigations underway; C - River Basin watershed investigation report complete; D - Field examination scope studies complete

2/ Includes cost for water control diversions and critical area

3/ Includes $89,400 for Fish Hatchery water supply

4-24879

Table 7a - Summary of Annual Benefits 1/ - Multiple-Purpose Projects for Early Action, Red River Basin Study Area

Tributary Basin and CNI Waters	Red:	Planning Status 2/	Flood Prevention: Damage Reduction: Land Treatment	Flood Prevention: Damage Reduction: Structural Measures 2/	Agricultural Water Management: More Intensive Land Use	Agricultural Water Management: Irrigation	Agricultural Water Management: Drainage	Nonagricultural Water Management: Municipal Water Supply	Nonagricultural Water Management: Water Quality Control	Recreation	Redevelopment	Secondary	Total Benefits from Structural Measures
							dollars						
Intervening Areas - Texas													
3-14		A	4,240	206,590*	1,000	2,450	1,000	67,920	0	157,920 4/	0	39,180	476,360
3-25		C	4,200	201,300*	69,800	0	0	0	0	0	0	58,400	330,000
3-25a		C	20,540	276,820*	59,060	0	0	19,400	13,500	71,100	0	62,400	502,280
3-27		A	260	2,430*	31,100	0	21,100	0	0	0	360	11,490	76,480
3-29		C	10	62,940*	0	0	62,740	0	0	7,400	480	17,160	150,760
3-33		A	3,220	205,980*	0	0	0	0	0	3,470 4/	7,830	25,000	245,250
Total			42,520	956,360	160,960	2,450	84,880	87,320	13,500	239,890	8,670	214,130	1,779,160
Intervening Areas - Arkansas and Oklahoma													
3-35		D	1,470	30,740*	8,820	0	9,460	0	0	16,350	0	6,220	72,540
3-39		A	7,150	46,220*	132,080	0	46,220	0	0	0	0	106,400	330,920
3-40		D	2,660	31,750*	26,900	0	31,750	0	0	0	0	8,610	99,010
3-41		C	3,370	100,420*	89,630	0	36,410	0	0	39,000	0	50,360	315,840
3-46		A	160	10,760*	17,370	0	7,100	0	0	2,750	5,820	4,260	48,060
Total			11,330	219,890	275,800	0	130,940	0	0	58,100	5,820	175,870	866,420
Blue River													
3-23		C	14,780	146,760*	113,250	0	0	57,480	10,000	86,150 5/	0	65,560	519,200
Total			14,780	146,760	113,250	0	0	57,480	10,000	86,150	0	65,560	519,200
Poplar Creek													
3b1-2		A	10,530	120,070*	32,240	0	0	0	0	0	0	19,840	172,150
3b1-3		A	1,370	28,310*	9,790	0	0	0	0	0	0	4,150	42,250
3b2-4 x 3b2-6		B,D	14,220	286,600*	73,730	0	0	13,530	0	51,600 4/	0	0	425,460
Total			26,120	434,980	115,760	0	0	13,530	0	51,600	0	23,990	639,860
Bianchi River													
3b-2		A	280	42,810*	31,590	0	9,830	0	0	0	2,300	10,810	97,340
3b-4		B	1,400	27,670*	26,550	0	0	33,340	0	30,000	8,550	10,170	136,580
3b-5		A	1,060	13,130*	52,390	0	0	0	0	4,140 4/	4,510	11,420	85,590
Total			3,240	83,610	110,530	0	9,830	33,340	0	34,140	15,360	32,400	319,510
Barkman Creek													
3-47		C	230	9,280	1,480	0	9,940	0	0	0	0	3,880	24,580
3-48		C	1,110	46,300	4,820	0	46,470	0	0	0	0	19,400	117,490
Total			1,340	55,580	6,300	0	56,410	0	0	0	0	23,280	142,070
Little River													
3-44		C	6,270	73,440	24,750	0	0	0	0	45,750	0	22,590	166,530
Total			6,270	73,440	24,750	0	0	0	0	45,750	0	22,590	166,530
McKinney Bayou													
3-52		C	3,010	130,820	47,740	0	130,820	0	0	61,800	0	37,120	408,300
3-53		C	4,330	192,740	22,920	0	192,740	0	0	0	0	40,840	449,240
3-54		C	1,730	75,190	29,390	0	75,180	0	0	0	0	17,980	197,740
Total			9,070	398,750	100,050	0	398,740	0	0	61,800	0	95,940	1,055,280
Sulphur River													
3x-9		D	2,210	22,330	11,750	0	0	0	0	0	0	3,055	37,135
3x-11		D	190	3,830	1,940	0	0	5,000	0	37,950	0	4,810	53,530
3x-12		C	1,390	12,150	1,600	0	0	0	0	0	0	3,010	16,760
3x-14		C	3,250	14,860	550	0	0	0	0	33,450	0	4,890	53,750
3x-17		C	10,810	42,820	3,860	0	0	0	0	0	0	17,780	106,460
3x-18		C	7,200	66,350	5,410	0	0	0	6,900	0	0	13,350	92,010
Total			30,050	202,340	27,110	0	0	5,000	6,900	71,400	0	46,895	359,645
Posten Bayou-Arkansas													
3-57		C	3,580	187,885	0	0	187,885	0	0	36,000	0	39,050	450,820
Total			3,580	187,885	0	0	187,885	0	0	36,000	0	39,050	450,820
Red River Main Stem													
3-60		D	420	30,340	0	0	30,340	0	0	0	0	5,800	66,440
Total			420	30,340	0	0	30,340	0	0	0	0	5,800	66,440
Buggy Bayou													
3m-1		A	530	3,150	3,360	0	0	0	0	0	100	2,300	9,440
3m1-7		C	2,210	42,210	36,860	0	0	101,600	26,200	82,100	0	48,200	337,170
3m2-3		A	1,050	52,920	5,580	234,100	36,750	35,200	0	193,800	0	113,200	671,550
Total			3,790	98,280	46,100	234,100	36,750	136,800	26,200	275,900	100	163,700	1,017,930
Bayou Pierre													
3n-2		C	740	52,370	38,110	27,770	0	0	0	37,050	0	42,150	197,450
Total			740	52,370	38,110	27,770	0	0	0	37,050	0	42,150	197,450
Cane River													
3-64		D	970	18,480	27,770	41,060	0	94,300	0	0	0	14,490	196,100
3-65		D	1,330	25,660	13,890	240,310	0	0	0	88,500	0	9,750	378,110
3-66		D	3,510	66,890	162,560	20,530	0	0	0	29,500	0	48,720	325,200
Total			5,810	111,030	204,220	301,900	0	94,300	0	118,000	0	72,960	902,410
Bayou Bigslette													
3-69		C	1,550	44,890	29,640	0	40,110	0	0	0	0	26,850	141,490
3-70		C	9,170	162,100	173,220	0	73,510	0	0	39,000	0	70,290	518,120
Total			10,720	206,990	202,860	0	113,620	0	0	39,000	0	97,140	659,610
Red River Backwater													
3-73		D	2,360	107,150	0	0	107,150	0	0	0	0	20,400	234,700
3-75		D	1,470	204,750	0	0	204,750	0	0	0	0	39,000	448,500
3-76		D	3,450	179,350	0	0	179,350	0	0	0	0	34,160	392,860
Total			7,280	491,250	0	0	491,250	0	0	0	0	93,560	1,076,060
Chatlin Lake & Associated Areas													
10-10		B,D	0	95,700	0	0	95,700	0	0	0	0	19,140	210,540
10-11&12		A	800	39,240	4,360	0	31,570	0	0	0	3,050	23,200	101,420
10-13&14		B,D	0	339,260	0	0	339,260	0	0	0	0	67,850	746,370
10-15		A	0	0	0	231,400	0	0	0	92,250	0	110,310	433,960
10-16		B,D	0	230,220	0	0	230,220	0	0	0	0	46,040	506,480
Total			800	704,420	4,360	231,400	696,750	0	0	92,250	3,050	266,540	1,998,770
Grand Total			179,710	4,494,275 2/	1,430,460	797,620	2,247,895	427,770	56,600	1,247,030	33,000	1,481,555	12,216,205

1/ Adjusted normalized prices, Water Resources Council, April 1966

2/ In addition, Red River Main Stem benefits aggregating approximately $29,150 annually accrue to watersheds with asterisks (*)

3/ Abbreviations: A - Authorized for operations; B - Workplan investigations underway; C - RB watershed investigation report complete; D - Field examination scope studies complete

4/ Includes incidental recreation benefits

5/ Includes $10,400 benefits from Fish Hatchery water supply

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About 50,000 acres in 100,000 farm ponds will provide incidental recreation benefits. These were not evaluated monetarily.

Damage reduction benefits from land treatment and structural measures include those relating to sediment deposition in existing and authorized reservoirs. Reduction in sediment depostiion aggregating 370 acre-feet annually is expected in seven watersheds. This represents monetary benefits of $2,630 from land treatment and $10,040 from structural measures. Benefits from reservoir sediment reduction by CNI watersheds are summarized in Exhibit 41.

Annual Costs and Benefit-Cost Comparisons

The operation and maintenance costs for structural installations include costs for routine replacement, maintenance and inspection of all structures and appurtenances. Costs include caretaker's salary for projects that have water quality control, irrigation, or recreation storage.

The amortized annual equivalents of installation costs amount to $3,995,220. Operation and maintenance costs, estimated at $994,110 bring the total annual cost of structural measures to $4,989,330. These costs include $188,000 for amortization and interest and $21,400 for maintenance and operation of USAE major outlets for CNI watersheds in McKinney Bayou, Posten Bayou, and Bayou Rigolette Tributary Basins. Costs of USAE improvements in Red River Backwater area watersheds are not included. The status of USAE plans for levee improvement is indefinite at this time and additionial studies by the USAE will be requested. However, benefits should be more than adequate to justify the cost of all structural measures.

The average annual benefits totaling $12,216,205 compared to the annual cost, would produce approximately $2.45 in benefits for each dollar spent on improvements. Annual equivalents of installation costs, annual operation and maintenance costs, annual benefits, and benefit-cost ratios for individual watershed projects are summarized in Table 76.

Single-Purpose Water and Related Land Resource Development

Recreational Development on National Forest System Lands

The USFS has completed detailed plans for developing water resources and recreation facilities within the Study Area for the 1962-1980 period. Table 77 shows the planned development of impoundments on National Forest lands of the Study Area to 1980. Work on Pine Creek Lake, Oklahoma, was started late in 1966. All other projects are scheduled for completion before 1980. These improvements are single-purpose reservoirs to be constructed with regular National Forest funds and will be developed for recreation. Most water areas will provide fishing, and waterfowl hunting will be developed on four impoundments.

Table 76 - Comparison of Average Annual Benefits and Costs for Structural Measures - Multiple-Purpose Projects for Early Action, Red River Basin Study Area

Tributary Basin and CNI Watershed	Planning Status 1/	Amortized Installation Cost	Operation and Maintenance Costs	Total Annual Costs	Benefits	Benefit-Cost Ratio
			dollars			
Intervening Areas - Texas						
3-19	A	285,580	28,580	314,160	476,360	1.5:1
3-25	C	134,400	58,000	192,400	330,000	1.7:1
3-25a	C	111,300	43,390	154,690	502,280	3.2:1
3-27	A	17,940	2,900	20,840	76,480	3.7:1
3-29	C	11,390	13,630	25,020	150,760	6.0:1
3-33	A	100,720	8,300	109,020	242,280	2.2:1
Total		661,330	154,800	816,130	1,778,160	2.2:1
Intervening Areas - Arkansas and Oklahoma						
3-35	D	24,120	12,700	36,820	72,590	2.0:1
3-39	A	106,240	14,800	121,040	330,920	2.7:1
3-40	D	25,820	7,850	33,670	99,010	2.9:1
3-41	C	52,700	27,740	80,440	315,840	3.9:1
3-46	A	30,650	6,430	37,080	48,060	1.3:1
Total		239,530	69,520	309,050	866,420	2.8:1
Blue River						
3-23	C	184,220	17,280	201,500	519,200	2.6:1
Total		184,220	17,280	201,500	519,200	2.6:1
Boggy Creek						
3h1-2	A	103,700	3,850	107,550	172,150	1.6:1
3h1-3	A	24,150	1,250	25,400	42,250	1.7:1
3h2-4 &	D					
3h2-6	B,D	251,110	24,500	275,610	425,460	1.5:1
Total		378,960	29,600	408,560	639,860	1.6:1
Kiamichi River						
3i-2	A	15,790	11,820	27,610	97,340	3.6:1
3i-4	B	50,480	20,220	70,700	136,580	1.9:1
3i-8	A	40,360	1,080	41,440	85,590	2.1:1
Total		106,630	33,120	139,750	319,510	2.3:1
Barkman Creek						
3-47	C	2,500	1,790	4,290	24,580	5.7:1
3-48	C	16,080	11,760	27,840	117,490	4.2:1
Total		18,580	13,550	32,130	142,070	4.4:1
Little River						
3j-4	C	100,310	14,470	114,780	166,530	1.5:1
Total		100,310	14,470	114,780	166,530	1.5:1
McKinney Bayou 2/						
3-52	C	122,930	49,550	172,480	408,300	2.4:1
3-53	C	47,770	28,620	76,390	449,240	5.9:1
3-54	C	44,620	14,340	58,960	197,740	3.4:1
Total		215,320	92,510	307,830	1,055,280	3.4:1
Sulphur River						
3k-9	D	28,190	1,180	29,370	37,135	1.3:1
3k-11	D	9,770	9,550	19,320	53,530	2.8:1
3k-12	C	12,200	500	12,700	16,760	1.3:1
3k-14	C	24,310	12,360	36,670	53,750	1.5:1
3k-17	C	57,150	10,190	67,340	106,460	1.6:1
3k-18	C	59,600	5,620	65,220	92,010	1.4:1
Total		191,220	39,400	230,620	359,645	1.6:1
Posten Bayou 2/						
3-57	C	118,640	42,860	161,500	450,820	2.8:1
Total		118,640	42,860	161,500	450,820	2.8:1

Continued ---

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Table 76 - Comparison of Average Annual Benefits and Costs for Structural Measures - Multiple-Purpose Projects for Early Action, Red River Basin Study Area -- Continued

Tributary Basin and CNI Watershed	Planning Status 1/	Amortized Installation Cost	Operation and Maintenance Costs	Total Annual Costs	Benefits	Benefit-Cost Ratio
			dollars			
Red River Main Stem						
3-60	D	4,600	2,400	7,000	66,480	9.5:1
Total		4,600	2,400	7,000	66,480	9.5:1
Loggy Bayou						
3m-1	A	4,520	360	4,880	8,910	1.8:1
3m1-7	C	150,980	55,570	206,550	337,170	1.6:1
3m2-3	A	274,690	94,880	369,570	671,850	1.8:1
Total		430,190	150,810	581,000	1,017,930	1.7:1
Bayou Pierre						
3n-2	C	91,450	21,030	112,480	197,450	1.8:1
Total		91,450	21,030	112,480	197,450	1.8:1
Cane River						
3-64	D	116,270	6,110	122,380	196,100	1.6:1
3-65	D	273,250	45,930	319,180	378,110	1.2:1
3-66	D	71,610	40,770	112,380	328,200	2.9:1
Total		461,130	92,810	553,940	902,410	1.6:1
Bayou Rigolette 2/						
3-69	C	6,970	10,590	17,560	141,490	8.1:1
3-70	C	221,440	77,340	298,780	518,120	1.7:1
Total		228,410	87,930	316,340	659,610	2.1:1
Red River Backwater						
3-73	D	12,400	5,200	17,600	234,700	13.3:1
3-75	D	30,000	12,600	42,600	448,500	10.5:1
3-76	D	102,500	12,000	114,500	392,860	3.4:1
Total		144,900	29,800	174,700	1,076,060	6.2:1
Chatlin Lake and Associated Areas						
10-10	B,D	23,730	20,670	44,400	210,540	4.7:1
10-11 & 12	A	61,260	8,380	69,640	101,420	1.5:1
10-13 & 14	B,D	95,140	34,660	129,800	746,370	5.8:1
10-15	A	184,000	23,310	207,310	433,960	2.1:1
10-16	B,D	55,670	15,200	70,870	506,480	7.1:1
Total		419,800	102,220	522,020	1,998,770	3.8:1
Grand Total		3,995,220	994,110	4,989,330	12,216,205	2.4:1

1/ Abbreviations: A - Authorized for operations; B - Workplan investigations underway; C - River Basin watershed investigation report completed; D - Field examination scope studies completed

2/ Includes USAE costs for major outlets

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Table 77 - Short-Term 1/ Single-Purpose Water Development on National Forests 2/, Red River Basin Study Area

Administrative Unit Name	Location - State and County	Drainage Area	Storage Capacity	Surface Area	Principal Use
		(sq.mi.)	acre-feet	acres	
Ouachita National Forest					
	Arkansas				
Rock Creek Lake	Polk	3.5	900	90	Recreation
Smokey Rock Creek Lake	Polk	1.5	500	50	Recreation
Total		5.0	1,400	140	---
	Oklahoma				
Talimena Scenic Drive 3/	LeFlore	1.5	200	20	Recreation
America Lake	McCurtain	4.0	320	80	Recreation 4/
Caney Lake	McCurtain	10.0	400	100	Recreation 4/
Moon Lake	McCurtain	12.0	500	125	Recreation 4/
Pine Creek Lake	McCurtain	2.0	50	42	Recreation 4/
Total		29.5	1,470	367	---
Grand Total	---	34.5	2,870	507	---

1/ Planned for 6/30/66 to 1980 period
2/ Single-purpose development with National Forest funds
3/ Name not designated, development integrated with recreation complex of Talimena Scenic Drive
4/ "Green-tree reservoir" developments. Water level control for wildfowl feeding and hunting

Recreation facilities to be developed on the impoundments in Table 6 are shown in Exhibit 42. Exhibit 42 shows facilities that will be developed in the June 30, 1966, to 1980 period and includes facilities added to other National Forests recreation developments on the base 1/ area.

The four impoundments planned for McCurtain County, Oklahoma, will be developed as "green-tree" reservoirs. Water level control devices are provided in construction that allows the flooding of adjoining hardwood timberlands. With the approach of waterfowl hunting seasons, the timbered areas in the reservoir are flooded to a level compatible with the feeding habits of shallow-water ducks (less than one foot). The areas are opened to the public for hunting during the State open season. Water levels are lowered and the water withdrawn from the

1/ All whole counties touched by the Study Area

Duck hunting on National Forest lands. The development of "green-tree" reservoirs for improved waterfowl habitat and public hunting is planned on National Forest lands in Oklahoma. (U. S. Forest Service Photo)

A water development for recreation on National Forest lands. Similar impoundments are planned on the Study Area in Arkansas. (U. S. Forest Service Photo)

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timberlands before the tree growth begins in the spring. Acorns and other mast and plant materials produced on low-lying hardwood areas are foods preferred by waterfowl such as the mallard, pintail, and teal ducks.

Some impoundments may be developed on National Forest System Lands as USDA proposals for small watershed development (under P. L. 566). Such proposals have been made in the Study Area for the 10-15 year period, on the following areas:

Watershed Name	CNI Number	County or Parish and State
Cocodrie and Little River	3-66	Natchitoches, Louisiana
Cane River	3-65	Natchitoches, Louisiana
Bayou Rigolette	3-70	Winn & Grant, Louisiana
Walnut Bayou	3-41	McCurtain, Oklahoma
Lower Bois d'Arc Creek	3-25	Fannin, Texas
Upper Middle Sulphur River	3k-17	Fannin, Texas

The National Forest System has determined that development of these projects is compatible with the objectives and purposes of multiple use on National Forest lands.

A complete study will be made to determine the feasibility and desirability of each preliminary site selection and proposed development. Any conflicts between USDA watershed proposals and the requirements of multiple-use management on National Forest System Lands will be resolved before any such proposals are considered for inclusion in a watershed plan of work.

Other Single-Purpose Reservoir Development

Single-purpose water storage data were developed in areas in which existing, planned, or proposed watershed projects could not meet all of the projected water and related land resource needs. These unsatisfied needs exist in areas in which development is urgently needed within 10-15 years.

Four municipal and industrial water supply sites were located in watersheds considered not feasible for project-type development. Four recreation sites were identified which could provide storage necessary to satisfy the projected recreation needs. One of the sites would be located in a CNI watershed approved for operations and three in watersheds considered not feasible for development. Site locations are shown in Figure 14.

Alexandria, Louisiana, has 1980 municipal and industrial water needs which can be partially satisfied by two reservoirs located in the authorized Bayou Rapides watershed project. One reservoir is located in CNI Watershed 3-68, and the other reservoir is located in CNI Watershed 10-17. Each of these reservoirs is designed to store the approximate yield of the drainage area, but limited to a total

storage of 25,000 acre-feet. One reservoir located in CNI Watershed 3-68 has an additional storage capacity of 36,200 acre-feet.

The towns of Ringgold and Gibsland, Louisiana, have 2080 municipal and industrial requirements which can be satisfied by two reservoirs located in nonfeasible CNI watersheds. The needs for Ringgold can be met by a reservoir located in CNI Watershed 3o1-3 and the needs for Gibsland can be met by a reservoir located in CNI Watershed 3o1-4.

A reservoir storage site to meet recreation needs near Atoka, Oklahoma, is located in CNI Watershed 3h1-2. This watershed is approved for operations.

Reservoir storage sites to meet recreation needs near Shreveport and Texarkana are located in nonfeasible watersheds. Two reservoirs near Shreveport are located in CNI Watershed 3n-5; one site near Texarkana is located in CNI Watershed 3-55.

The total capacity of the reservoirs is 185,260 acre-feet. Of this amount, 53,000 acre-feet is for municipal and industrial water supply, 31,500 acre-feet for recreation, 6,090 acre-feet for sediment accumulation, and 94,670 acre-feet could be additional potential storage for future development. The total surface area of the permanent pools is approximately 6,820 acres of which 2,950 acres are for recreational use. Recreation basic facilities for picnicking, boating, fishing, camping, and swimming were included at the sites with recreation storage. Reservoir storage data are summarized in Table 78.

Table 78 - Pertinent Structural Data- Additional Reservoir Development for Early Action, Red River Basin Study Area

Tributary Basin and CNI Watershed	Number of Structures	Drainage Area above Structures	Pool Capacity			Surface Area of Permanent Pool	Additional Storage Available
			Recreation	Municipal & Industrial	Sediment		
	number	(sq. mi.)	acre-feet			acres	acre-feet
WATERSHEDS FEASIBLE FOR INITIAL DEVELOPMENT							
Boggy Creek							
3h1-2	1	25.1	2,010	-	950	360	0
Subtotal	1	25.1	2,010	-	950	360	0
Bayou Rapides							
3-68	1	33.8	-	23,500	1,500	1,600	36,200
10-17	1	11.8	-	21,400	500	1,470	0
Subtotal	2	45.6	-	44,900	2,000	3,070	36,200
Total	3	70.7	2,010	44,900	2,950	3,430	36,200
WATERSHEDS NOT FEASIBLE FOR DEVELOPMENT							
Bayou Pierre							
3n-5	2	65.0	21,990	-	2,430	2,040	44,020
Subtotal	2	65.0	21,990	-	2,430	2,040	44,020
McKinney Bayou							
3-55	1	8.0	7,500	-	300	550	4,950
Subtotal	1	8.0	7,500	-	300	550	4,950
Black - Saline							
3o1-3	1	5.5	-	3,100	240	340	3,700
3o1-4	1	3.8	-	5,000	170	460	5,800
Subtotal	2	9.3	-	8,100	410	800	9,500
Total	5	82.3	29,490	8,100	3,140	3,390	58,470
Grand Total	8	153.0	31,500	53,000	6,090	6,820	94,670

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Installation costs based upon USDA design criteria were computed for reservoir site and recreation basic facilities. The estimated installation cost for the reservoirs is $7,634,390. Of this amount, $3,636,310 is for municipal and industrial water supply, and $3,998,080 is for recreation water storage and basic facilities. Of the recreation costs, $1,281,000 will be assumed by the Federal Government and $2,717,080 will be assumed by nonFederal interest. All municipal and industrial water supply costs will be assumed by nonFederal interests.

Operation and maintenance costs include costs for structural maintenance and a caretaker's salary for sites with recreation storage. The total operation and maintenance cost is $69,040 of which $800 is for municipal and industrial water supply, and $68,240 is for recreation.

Benefits from municipal and industrial water supply were considered equal to the cost of the reservoirs. The annual costs consisting of the amortized annual equivalent of installation cost plus allowance for operation and maintenance is estimated at $119,930. Benefits and costs are shown for each watershed with storage for municipal and industrial water supply in Table 79.

Table 79 - Comparison of Benefits and Cost - Additional Reservoir Development for Early Action, Red River Basin Study Area

Tributary Basin and CNI Watershed	Storage Purpose 1/	Installation Cost	Annual Costs: Amortized Installation	Annual Costs: O & M	Annual Costs: Total	Average Annual Benefits	Benefit-Cost Ratio
		dollars					
WATERSHEDS FEASIBLE FOR INITIAL DEVELOPMENT							
Boggy Creek							
3h1-2	R	1,427,390	46,760	29,840	76,600	118,800	1.6:1
Subtotal		1,427,390	46,760	29,840	76,600	118,800	1.6:1
Bayou Rapides							
3-68	M	1,887,260	61,830	200	62,030	62,030	1.0:1
10-17	M	1,175,160	38,500	200	38,700	38,700	1.0:1
Subtotal		3,062,420	100,330	400	100,730	100,730	1.0:1
Total		4,489,810	147,090	30,240	177,330	219,530	1.2:1
WATERSHEDS NOT FEASIBLE FOR DEVELOPMENT							
McKinney Bayou							
3-55	R	590,500	19,340	12,800	32,140	181,500	5.6:1
Subtotal		590,500	19,340	12,800	32,140	181,500	5.6:1
Bayou Pierre							
3n-5	R	1,980,190	64,870	25,600	90,470	673,200	7.4:1
Subtotal		1,980,190	64,870	25,600	90,470	673,200	7.4:1
Black & Saline Lakes							
3o1-3	M	273,000	8,940	200	9,140	9,140	1.0:1
3o1-4	M	300,890	9,860	200	10,060	10,060	1.0:1
Subtotal		573,890	18,800	400	19,200	19,200	1.0:1
Total		3,144,580	103,010	38,800	141,810	873,900	6.2:1
Grand Total		7,634,390	250,100	69,040	319,140	1,093,430	3.4:1

1/ Purpose Abbreviations - R-Recreation, M-Municipal and Industrial Water Supply

Benefits from the potential recreation storage and basic recreation facilities in four reservoirs in three CNI watersheds would amount to $973,500 annually. These are based on an estimated 649,000 visitor-days of recreation use. The annual cost, consisting of the amortized annual equivalent of installation cost and allowance for operation and maintenance, totals $199,210. These, compared to the expected benefits, would give a benefit-cost ratio of 4.9:1.0. Benefits and costs are shown for each watershed with potential for recreation in Table 79. A summary of pertinent data, including estimated days of recreation use in potential reservoirs, is shown in Exhibit 43.

The amortized annual equivalent of installation costs for additional storage potential, including municipal and industrial water supply and recreation purposes is $250,100. Operation and maintenance costs, estimated at $69,040 bring the total cost to $319,140. Average annual benefits for the combined purposes total $1,093,430. These benefits compared to the annual cost would result in a benefit-cost ratio of 3.4:1. Table 79 shows storage purposes and summarized annual costs and benefits by CNI watersheds for all additional storage development recommended for early action.

Land Treatment

Approximately 16,600 square miles of land are included in the projects recommended for early action by the USDA and other agencies. Land treatment is needed on the lands included in these projects. Treatment needs include measures that have a significant effect on reducing runoff, erosion, and sediment production. Treatment also is needed on lands benefiting from drainage improvement and irrigation development. Treatment measures should be designed to improve the woodland and agricultural lands and increase overall farming efficiency.

Land treatment needs have been developed, and it was determined that going programs will not accomplish the needs for project development. Approximately 501,600 acres of land included in projects recommended for early action require acceleration of the installation of land treatment measures.

Recommendations

The U. S. Department of Agriculture recommends that the early-action program be carried out in the basin, with the installation of all elements of the program being initiated prior to 1980;

That in carrying out such program, the USDA will assist local organizations, upon their request, to prepare and carry out subwatershed work plans for the subwatersheds designated in the early-action program;

That in carrying out such program, the USDA will provide financial and other assistance in the installation of structural works of improvement for furthering the conservation, development, utilization, and disposal of water and that such assistance should be provided on a basis comparable to that authorization for similar purposes under other Federal

programs, with such modifications as are necessary and appropriate in the public interest;

That prior to participation in the installation of the upstream structural works of improvement and the measures for sediment and erosion control described herein on non-Federal lands, cooperating non-Federal interests shall furnish assurances satisfactory to the Secretary of Agriculture that an adequate land treatment program is being installed to provide necessary protection to the watershed lands and planned structural measures; they will acquire, with such Federal financial assistance as is provided for herein, all land rights needed in connection with the installation of such works of improvement; and they will maintain and operate all upstream structural works of improvement and measures for sediment and erosion control on non-Federal lands after installation in accordance with the provisions for non-Federal participation described herein or as may be available for such purposes under other Federal programs;

That the installation of the planned works of improvement may be carried out under Federal construction contracts when requested by the local organization (s);

That the first estimate of costs for the installation of the upstream structural works of improvement is $116,277,900 of which $75,604,567 will be assumed by the Federal Government and $40,673,333 will be assumed by non-Federal interests.

WATERSHED DEVELOPMENT ALTERNATIVES

The USAE proposed early-action reservoir projects in several subwatersheds that are planned for development under the USDA early-action program. The USDA was requested to modify proposals for USDA project development to accommodate USAE proposals. This resulted in alternatives to the USDA early-action recommended program in several upstream watersheds. USDA recommendations would be modified by combined project plans that include major reservoirs and upstream watershed improvements for CNI Watersheds 3-23, 3-25, 3-25a, 3h2-4, and 3h2-6. Kisatchie Reservoir would eliminate Cane River Tributary Basin upstream watershed development.

Tables 80-83 show pertinent structural data, estimated installation costs, benefit summaries, and average annual benefits and costs for the combined projects for early action. SCS study intensity for the upstream watershed development features of the potential projects is comparable to study intensity shown in Tables 72-77. Benefits were allocated equitably to elements of the combined projects by mutual agreement of the two planning agencies.

Bois d'Arc Creek Watersheds

The combined project plan for CNI Watersheds 3-25 and 3-25a (Bois d'Arc Creek Watersheds, Texas), includes Bonham Reservoir, a site proposed by the USAE, across Bois d'Arc Creek approximately three and one-half miles south of Bonham, two upstream reservoirs above the Bonham Reservoir Site and 20 below the Site, and channel improvement from the proposed Bonham Site to Red River. Approximately 17,730 acre-feet of conservation storage could be provided in three upstream reservoirs. Estimated annual benefits of the combined project are $1,339,140 and

Table 80 - Pertinent Reservoir and Channel Data - Alternate Potential Multiple-Purpose Watershed Projects for Early Action, Red River Basin Study Area

Tributary Basin and CNI Watershed	Agency Participation	Watershed Area	Drainage Area Controlled	Number of Reservoirs	Channel Improvement	Reservoir Storage: Sediment	Reservoir Storage: Flood Control	Reservoir Storage: Other 1/	Surface Area Permanent Pool
		(sq.mi.)	(sq.mi.)	number	miles	- acre-feet -	- acre-feet -	- acre-feet -	acres
Intervening Areas - Texas									
3-25a	SCS	223	79	8	8.1	5,820	32,910	17,730 RWM	1,931
	CE	---	108 2/	1	0	6,960	48,500	82,040	5,280
3-25	SCS	208	96	14	22.2	8,910	32,610	0	1,385
Total	Joint	431	263	23	30.3	21,690	114,020	99,770	8,596
Lower Blue River, Oklahoma									
3-23	SCS	360	77	13	0	6,010	33,920	5,050 RWF	1,155
	CE	---	649 3/	1	0	14,480	232,200	147,020	8,980
Total	Joint	360	649	14	0	20,490	266,120	152,070	10,135
Boggy Creek, Oklahoma									
3h2-6	SCS	322	158	44	0	8,400	50,500	3,000 RM	780
	CE	---	172 4/	1	0	6,970	75,200	114,630	6,110
3h2-4	SCS	225	155	25	0	8,250	49,250	2,000 M	450
Total	Joint	547	485	70	0	23,620	174,950	119,630	7,340
Cane River, Louisiana									
	CE (Plans I and II)	---	277	1	NA 5/	8,000	169,200	119,200 M	9,180
Total		---	277	1	NA	8,000	169,200	119,200	9,180

1/ R-Recreation; M-Municipal; I-Irrigation; W-Water Quality Control; F-Fish and Wildlife
2/ Includes 20 square miles in SCS sites
3/ Includes 77 and 219 square miles in SCS sites in CNI Watershed 3-23 and 3-23a, respectively
4/ Includes 66 square miles in SCS sites
5/ Data for irrigation distribution system not available

Table 81 - Estimated Structural Installation Costs 1/ - Alternate Multiple-Purpose Watershed Projects for Early Action, Red River Basin Study Area

Tributary Basin and CNI Watershed	Agency Participation	Construction: Floodwater Retarding Structures	Construction: Multiple-Purpose Structures	Construction: Channel Improvements	Construction: Recreation: Basic Facilities	Construction: Subtotal	Land: Installation Services	Land: Easements and Rights of way	Administration of Contracts	Total
		- - - - - - - - - - - - dollars - - - - - - - - - - - -								
Intervening Areas - Texas										
3-25a	SCS	419,320	729,630	403,150	165,000	1,717,100	335,990	703,430	8,580	2,765,100
	CE	Data not available								14,855,000
3-25	SCS	1,018,600	0	2,451,900	0	3,470,500	695,320	761,280	17,320	4,944,420
Total	Joint	Data not available								22,564,520
Blue River, Oklahoma										
3-23	SCS	758,180	587,420	0	165,000	1,537,600	415,140	511,530	6,980	2,471,250
	CE	Data not available								20,100,000
Total	Joint	Data not available								22,571,250
Boggy Creek, Oklahoma										
3h2-6	SCS	1,910,000	424,625	0	165,000	2,499,625	607,150	425,500	14,780	3,547,055
	CE	Data not available								9,930,000
3h2-4	SCS	1,975,000	196,000	0	0	2,171,000	507,000	203,000	7,500	2,888,500
Total	Joint	Data not available								16,365,555
Cane River, Louisiana										
	CE (Plan I)	14,313,300		NA	4,324,000	18,637,300	NA	1,475,800	NA	20,113,100
	CE (Plan II)	14,313,300		NA	70,000	14,383,300	NA	1,475,800	NA	15,859,100

1/ 1966 Price Base

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Table 82 - Summary of Average Annual Benefits - Alternate Multiple-Purpose Watershed Projects for Early Action, Red River Basin Study Area

Tributary Basin and CNI Watershed	Agency Participation	Damage Reduction: Watershed	Damage Reduction: Red River Main Stem	More Intensive Land Use	Reduction in CE Reservoir Cost	Municipal and Industrial	Recreation	Commercial Fishing	Other 2/	Total Benefits
		- - - - - - - - - - - dollars - - - - - - - - - - -								
Intervening Areas - Texas										
3-25 & 25a	CE	121,230	0	57,270	---	251,000	334,900	7,000	0	771,400
	SCS	324,860	4,580	134,290	0	71,100	19,410	0	13,500 W	567,740
Total	---	446,090	4,580	191,560	0	322,100	354,310	7,000	13,500	1,339,140
Blue River, Oklahoma										
3-23	CE	137,710	177,370	58,720	---	493,200	240,000	10,200	0	1,117,200
	SCS	73,830	2,370	29,460	5,200	75,750	0	10,400	10,000 W	207,010
Total	---	211,540	179,740	88,180	5,200	568,950	240,000	20,600	10,000	1,324,210
Boggy Creek, Oklahoma										
3h2-6,3h2-4	CE	93,530	0	59,940	---	571,000 1/	218,800	8,000	0	951,270
	SCS	253,885	0	65,045	0	51,600 1/	13,530	0	0	384,060
Total	---	347,415	0	124,985	0	622,600	232,330	8,000	0	1,335,330
Cane River, Louisiana										
	CE (Plan I)	395,900	0	0	---	2,486,000	111,400	0	235,000 I	3,228,300
	CE (Plan II)	395,900	0	0	---	260,000	111,400	0	235,000 I	1,002,300

1/ Includes incidental benefits
2/ Abbreviations: W-Water quality control, I-Irrigation

Table 83 - Average Annual Benefits and Costs for Structural Measures - Alternate Multiple-Purpose Watershed Projects for Early Action, Red River Basin Study Area

Tributary Basin and CNI Watershed	Agency Participation	Amortized Installation Costs	Operation and Maintenance	Total Annual Costs	Benefits	Benefit-Cost Ratio
		- - - - - - - - - - dollars - - - - - - - - - -				
Intervening Areas - Texas						
3-25 & 25a	CE	486,700	118,700	605,400	771,400	1.3:1.0
	SCS	252,560	86,340	348,900	567,740	1.6:1.0
Total	---	739,260	215,040	954,300	1,339,140	1.4:1.0
Blue River, Oklahoma						
3-23	CE	698,100	159,700	857,800	1,117,200	1.3:1.0
	SCS	80,960	14,470	95,430	207,000	2.2:1.0
Total	---	779,060	174,170	953,230	1,324,210	1.4:1.0
Boggy Creek, Oklahoma						
3h2-6,3h2-4	CE	339,800	131,200	471,000	951,270	2.0:1.0
	SCS	210,830	22,500	233,330	384,060	1.6:1.0
Total	---	550,630	153,700	704,330	1,335,330	1.9:1.0
Cane River, Louisiana						
	CE (Plan I)	- - Not Available - -		1,203,600	3,228,300	2.7:1.0
	CE (Plan II)	- - Not Available - -		735,200	1,002,300	1.4:1.0

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annual costs are $954,300, resulting in a benefit-cost ratio of approximately 1.4:1.0.

The potential benefit area in the combined project plan is estimated at 21,265 acres as compared to 26,430 acres for the potential USDA development plan. Of this difference in acreage, approximately 2,900 acres, consisting of the intensively farmed floodplain, would be inundated by the Bonham Reservoir. Total installation cost of the USDA potential plan of development would be approximately 7.5 million dollars, and installation costs of structural measures in the potential combined project would be approximately 22.6 million dollars. Recreation and municipal and industrial water storage in the USAE reservoir would be additional to that in the USDA developments. Municipal and industrial water supply storage, with dependable yield estimated at 6.2 mgd in the USDA potential development, would be adequate for 100-year needs for Bonham, Texas. Bonham Reservoir in the combined USAE-SCS potential plan includes benefits from commercial fishing.

Lower Blue River Watershed

The combined project plan for CNI Watershed 3-23 (Lower Blue River Watershed) includes Durant Reservoir on Blue River northeast of Wade, and 13 upstream reservoirs above a site proposed by the USAE. An additional 74 upstream reservoirs are planned above the Durant Site in CNI Watershed 3-23a. In CNI Watershed 3-23, 2,000 acre-feet of recreational storage, 2,050 acre-feet of water quality storage, and 1,000 acre-feet of fish and wildlife storage were included in three sites. The combined potential project would have estimated average annual benefits of $1,324,210 and average annual costs of $953,230. The benefit-cost ratio is estimated at 1.4:1.0.

The potential benefit area in the combined project plan is estimated at 12,650 acres. Of this amount, the benefit area directly affected by the upstream watershed development portion of the combined project would be confined to 6,719 acres, compared to a potential benefit area of 17,840 acres in the upstream watershed project. This difference consists primarily of 6,620 acres of fertile floodplain inundated by Durant Reservoir. Approximately 2,575 acres of potential benefit area under the USDA potential plan would lie below the Durant Reservoir in the combined project.

Total installation cost of the USDA potential structural developments in Lower Blue River are estimated at $5,623,330, while installation costs of the structural measures in the combined project are $22,571,250. Recreation in the Durant Reservoir would be additional to that in the upstream watershed project. Municipal and industrial water storage in the upstream watershed project would be replaced by storage in the Durant Reservoir with a yield of 30 mgd. The upstream watershed project would be adequate for 50-year needs. Existing pipeline and pumping facilities could be used in connection with the municipal and industrial storage in the upstream watershed project, but in order to utilize

water supply from the Durant Reservoir, pipeline and pumping facilities for a considerable higher lift would be required to move water into Durant.

Muddy Boggy Creek Watersheds

The combined project plan for CNI Watersheds 3h2-4 and 3h2-6 (Muddy Boggy Creek) includes Parker Reservoir, a site proposed by the USAE, and 69 upstream reservoirs. Of these, 16 would be above Parker Reservoir and 53 would be below Parker Reservoir.

The potential benefit area in the combined potential project would be approximately 22,000 acres compared to 29,000 acres in the upstream watershed project. An estimated 5,725 acres of potential benefit area in the upstream watershed plan would be inundated by Parker Reservoir in the alternate potential project. Recreation and municipal and industrial water supply with a yield of 47 mgd in the Parker Reservoir is in addition to that proposed in the upstream watershed plan. The upstream watershed project would be adequate for 50-year needs. The Parker Reservoir includes benefits from commercial fishing. The cost of structural measures in the combined plan is estimated at over $16 million, compared to $7.6 million for the upstream watershed project. Average annual benefits from the combined potential project were estimated at $1,335,330, compared to $425,460 in the upstream watershed project.

Cane River Tributary Basin Watersheds

Two alternative plans for Cane River Tributary Basin Watersheds includes Kisatchie Reservoir, a site proposed by the USAE, on Kisatchie Bayou near its mouth. The reservoir would control approximately 277 square miles of drainage area. It would include storage for irrigation, municipal and industrial water supply, recreation, and flood control purposes. The primary difference between the two plans (Plan I and Plan II) is the degree of recreation development.

In Cane River, Louisiana, the potential benefit area from flood damage reduction for the upstream watershed project is estimated at 64,625 acres; however, monetary benefits would accrue primarily on approximately 41,750 acres of Red River alluvium, most of which would also be benefitted by the USAE potential projects. The total installation cost of the upstream watershed project is estimated at $14,075,790 compared to costs of $20,113,100 and $15,859,100 for the USAE Plan I and Plan II, respectively. The upstream watershed project would include recreation storage and basic recreation facilities at four sites, irrigation storage in four sites, and municipal water in five sites. All potential reservoirs would include sediment and detention storage. The combined surface area of permanent pools in the 38 upstream reservoirs amounts to 9,052 acres, while Kisatchie Reservoir inundates an estimated 9,180 acres. Average annual benefits from the potential upstream watershed project are estimated at $902,410 compared to $3,228,300 for USAE Plan I and $1,002,300 for Plan II.

4-24577

Exhibit 1. - Production of major crops: Delta and Southern Plains Areas as a percent of national production, 1939-1963, projected 1980

Year	Barley		Corn for grain		Cotton		Fruits non-citrus		Oats		Peanuts	
	Delta	Southern Plains	Delta	Southern Plains	Delta	Southern Plains	Delta	Southern Plains	Delta	Southern Plains	Delta	Southern Plains
	percent								percent			
1939	0.1	4.3	4.0	4.1	31.7	29.4	-	-	1.4	6.4	1.8	13.0
1940	-	4.0	4.9	5.9	25.5	33.1	1.5	1.3	1.2	6.5	1.1	13.8
1941	0.1	4.8	4.5	4.0	29.4	32.4	1.7	1.3	1.6	5.5	1.3	13.7
1942	-	3.8	3.7	3.6	31.6	30.1	1.5	1.1	1.5	2.7	1.8	25.0
1943	0.1	2.5	3.0	3.6	32.4	29.0	0.8	0.8	1.8	4.0	1.3	15.7
1944	0.1	5.1	2.9	3.0	32.4	27.7	1.3	0.9	2.5	6.1	0.6	19.2
1945	0.1	1.7	3.6	2.8	33.2	24.2	1.5	1.2	1.7	3.9	0.6	20.5
1946	0.2	2.6	2.7	2.5	29.8	24.0	1.3	0.9	1.3	4.1	0.5	25.5
1947	-	1.6	3.3	3.1	28.2	33.3	1.2	0.8	1.7	5.1	0.4	23.6
1948	0.1	1.0	2.7	1.9	34.2	25.3	1.4	0.6	1.4	1.8	0.5	19.8
1949	0.1	1.6	2.7	2.5	23.4	42.9	1.0	0.9	0.8	3.2	0.5	24.2
1950	-	1.0	3.5	3.0	28.4	33.7	0.9	0.4	0.8	3.2	0.4	22.7
1951	-	0.5	2.8	2.3	23.8	31.8	0.6	0.7	0.5	0.9	0.4	14.4
1952	0.1	0.9	1.6	1.5	26.6	29.1	0.8	0.5	0.9	2.3	0.3	10.5
1953	0.1	1.3	1.9	1.2	27.2	30.9	0.9	0.5	1.6	4.2	0.3	19.0
1954	0.3	2.3	1.6	1.3	25.5	33.2	0.6	0.4	2.3	4.2	0.3	15.3
1955	0.4	1.4	2.9	1.8	28.9	32.4	0.0	0.2	2.1	2.3	0.3	24.2
1956	0.5	1.8	2.2	1.0	27.2	31.4	1.0	0.5	3.0	2.6	0.2	9.1
1957	0.4	3.1	1.8	1.4	22.0	37.7	0.4	0.4	1.9	3.6	0.4	17.2
1958	-	5.8	1.9	1.4	19.0	42.7	1.0	0.6	0.8	5.0	0.2	20.5
1959	0.1	5.1	1.6	1.3	24.8	35.2	0.8	0.3	1.5	3.2	0.2	22.0
1960	0.1	6.3	1.2	0.9	23.7	35.7	0.8	0.4	1.2	3.2	0.1	21.7
1961	0.2	7.9	1.5	1.0	24.9	38.1	0.6	0.3	1.4	4.4	0.1	22.2
1962	0.2	3.3	0.9	1.0	24.9	35.8	0.7	0.3	1.1	2.2	0.1	22.2
1963	0.1	3.2	1.0	0.7	27.8	33.7	0.7	0.3	0.5	1.9	0.1	19.0
1980	0.3	6.0	0.3	0.5	26.0	35.0	0.3	0.1	1.0	3.0	-	20.0

Exhibit 1. - Continued

Year	Potatoes		Rice		Sorghum for grain		Soybeans		Sugar cane		Sweet potatoes	
	Delta	Southern Plains	Delta	Southern Plains	Delta	Southern Plains	Delta	Southern Plains	Delta	Southern Plains	Delta	Southern Plains
	percent								percent			
1939	1.9	1.4	55.3	28.1	0.3	62.5	-	-	-	-	23.2	5.9
1940	1.9	1.5	52.1	30.6	0.3	53.3	1.7	0.1	75.8	-	20.3	10.9
1941	1.9	2.3	61.0	22.6	0.1	64.1	2.5	-	80.7	-	25.5	11.2
1942	2.2	1.9	55.9	24.6	0.1	68.4	3.6	0.2	88.0	-	23.8	7.8
1943	2.1	1.9	52.0	25.6	0.1	74.2	2.4	0.1	88.5	-	25.1	9.7
1944	2.3	1.7	52.9	25.3	0.1	64.9	2.5	-	86.3	-	25.4	9.8
1945	1.6	1.3	53.2	26.4	0.2	70.1	2.5	-	83.3	-	32.1	9.0
1946	1.5	1.6	51.1	24.5	0.1	75.7	3.6	-	81.2	-	28.5	10.4
1947	1.3	1.4	49.9	27.3	0.2	77.3	2.9	-	81.0	-	26.0	9.0
1948	0.9	1.2	53.4	28.7	0.3	65.8	4.0	-	83.9	-	30.1	6.9
1949	0.9	1.1	48.6	26.2	0.3	69.1	4.1	0.1	81.6	-	28.4	10.5
1950	0.8	0.7	48.8	29.8	0.2	73.0	7.5	0.1	82.0	-	30.8	8.7
1951	0.8	0.9	47.4	29.3	0.2	58.0	6.5	0.4	78.0	-	32.5	5.4
1952	0.6	0.7	46.9	28.7	0.4	66.7	7.1	0.3	79.1	-	34.0	5.0
1953	0.6	0.8	47.9	28.5	0.4	58.6	4.5	0.2	79.9	-	32.0	8.0
1954	0.8	0.7	54.2	26.5	0.2	62.3	5.1	0.1	81.7	-	34.9	5.7
1955	0.6	0.9	53.3	26.2	0.9	69.5	9.6	0.1	83.0	-	35.7	9.7
1956	0.5	0.8	51.8	23.6	1.0	64.6	9.1	0.2	80.1	-	35.3	4.5
1957	0.4	1.0	51.2	25.9	1.0	46.9	9.6	0.2	78.6	-	31.0	7.4
1958	0.4	1.1	48.7	26.2	0.9	47.9	12.3	0.4	76.9	-	32.8	7.5
1959	0.4	1.2	50.5	24.5	0.3	51.2	15.0	0.7	74.1	-	32.0	9.1
1960	0.3	1.2	51.1	23.5	0.2	47.0	13.7	0.8	78.2	-	25.8	9.3
1961	0.2	1.2	52.2	21.9	0.2	53.4	11.3	0.8	77.8	-	30.7	6.8
1962	0.2	1.2	50.7	24.8	0.1	45.3	12.6	0.7	56.8	-	26.2	9.1
1963	0.2	1.1	52.7	26.2	0.1	48.1	11.8	0.6	62.5	-	30.3	7.2
1980	0.2	0.8	49.8	23.0	0	41.0	16.0	0.5	68.0	-	29.0	8.0

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Exhibit 1. - Production of major crops: Delta and Southern Plains Areas as a percent of national production, 1939-1963, projected 1980--- Continued

Year	Vegetables		Wheat, all	
	Delta	Southern Plains	Delta	Southern Plains
	percent			
1939	2.7	7.4	-	12.5
1940	2.5	6.9	0.1	11.4
1941	2.2	5.6	-	8.8
1942	2.6	8.0	-	12.3
1943	2.0	7.3	-	9.4
1944	2.4	9.1	0.2	16.1
1945	2.3	8.9	0.1	11.3
1946	2.0	8.7	-	13.4
1947	1.8	8.5	-	16.9
1948	1.7	8.2	-	12.4
1949	1.8	8.6	0.1	16.4
1950	1.7	7.5	-	6.2
1951	1.4	5.4	-	5.8
1952	1.3	6.3	0.1	11.1
1953	1.4	7.1	0.3	8.2
1954	1.3	7.4	0.3	10.6
1955	1.8	7.4	0.2	4.3
1956	1.2	7.1	0.4	9.6
1957	1.2	7.2	0.9	8.2
1958	1.1	7.9	0.4	13.0
1959	1.1	6.9	0.5	13.3
1960	0.9	7.7	0.5	15.0
1961	0.9	6.7	0.6	16.5
1962	0.8	5.9	0.4	10.9
1963	0.9	6.9	0.7	10.5
1980	1.0	6.5	0.5	12.5

Continued - - - - - - -

Exhibit 1. - Production of major livestock products: Delta and Southern Plains Areas as a percent of national production, 1939-63, projected 1980

Year	Broilers		Beef and veal		Eggs		Farm chickens	
	Delta	Southern Plains	Delta	Southern Plains	Delta	Southern Plains	Delta	Southern Plains
	- - - - - - - - - - - - - - - - percent - - - - - - - - - - - - - - - -							
1939	9.2	4.7	3.7	15.2	3.5	8.5	4.5	7.1
1940	7.6	4.1	3.5	14.3	3.2	8.6	4.5	7.0
1941	8.8	3.7	3.4	14.8	3.2	8.7	4.6	7.7
1942	6.1	4.1	3.4	15.9	3.2	8.8	4.4	7.7
1943	6.7	4.1	3.5	15.7	3.3	8.9	4.3	7.5
1944	5.7	3.7	3.6	15.4	3.1	9.2	4.1	7.1
1945	5.3	3.2	3.7	15.3	3.1	8.9	3.8	6.8
1946	6.1	3.4	3.9	15.1	3.0	8.1	4.3	6.4
1947	6.2	3.1	3.7	14.9	2.8	7.7	3.9	6.5
1948	7.8	3.6	3.6	15.0	2.9	7.3	4.7	6.0
1949	9.2	4.7	3.5	15.6	3.0	7.1	4.4	6.2
1950	9.9	5.0	3.6	15.6	3.1	6.9	4.2	5.5
1951	11.3	6.5	3.9	15.2	3.0	6.4	3.6	5.1
1952	11.9	7.2	4.2	14.8	2.8	6.5	3.6	4.4
1953	11.5	7.2	4.7	13.9	2.7	5.8	2.9	4.4
1954	11.3	7.0	4.9	13.6	2.6	5.5	2.9	4.0
1955	10.7	7.4	4.9	13.7	2.5	5.4	2.9	3.6
1956	11.3	7.4	4.8	14.1	2.8	5.5	2.9	4.1
1957	12.3	7.0	5.3	12.9	2.9	5.5	3.3	3.5
1958	13.4	6.7	5.0	13.4	3.0	5.5	3.8	4.4
1959	15.8	6.6	4.5	13.8	3.8	5.6	5.1	4.4
1960	16.5	6.0	4.4	14.7	4.2	5.2	4.4	4.6
1961	18.5	6.2	4.5	14.8	4.9	5.4	5.1	5.3
1962	19.0	6.4	4.4	15.2	5.6	5.2	5.9	5.0
1963	20.2	6.5	4.2	15.2	6.6	5.0	7.2	4.8
1980	24.0	8.0	5.3	14.0	7.0	6.0	7.0	6.0

Exhibit 1. - Continued

Year	Pork		Milk		Lamb & mutton		Turkeys	
	Delta	Southern Plains	Delta	Southern Plains	Delta	Southern Plains	Delta	Southern Plains
	- - - - - - - - - - - - - - - - percent - - - - - - - - - - - - - - - -							
1939	3.8	5.1	3.0	6.5	0.4	14.6	0.7	17.0
1940	3.0	4.3	2.9	6.2	0.4	15.4	0.8	15.7
1941	2.9	4.3	2.9	6.3	0.4	14.2	1.0	13.4
1942	2.9	4.8	2.9	6.3	0.3	16.0	0.9	12.5
1943	3.0	5.2	3.0	6.2	0.2	14.0	0.7	11.8
1944	3.0	4.6	3.0	6.1	0.3	16.9	0.7	10.3
1945	3.1	4.3	3.0	5.7	0.4	17.8	0.6	9.6
1946	3.0	4.1	2.9	5.4	0.3	16.6	0.5	8.8
1947	3.2	3.8	2.9	5.2	0.3	16.7	0.6	8.9
1948	3.1	4.0	3.0	4.9	0.3	13.1	0.7	7.1
1949	2.9	3.6	2.9	4.7	0.3	16.2	0.9	7.3
1950	2.8	3.5	2.9	4.9	0.3	17.5	1.5	7.4
1951	2.3	3.6	2.9	4.6	0.3	14.2	1.5	6.9
1952	2.3	3.1	2.9	4.4	0.4	12.1	1.4	7.0
1953	1.9	2.3	2.9	4.3	0.5	12.2	2.4	6.5
1954	1.7	2.3	2.9	4.1	0.6	12.0	2.5	6.0
1955	1.9	2.5	2.9	4.0	0.6	11.9	2.5	6.1
1956	2.2	2.6	2.8	4.0	0.5	12.6	3.3	7.5
1957	1.9	2.1	2.8	3.9	0.6	11.3	3.4	7.6
1958	1.7	2.1	2.6	3.9	0.6	12.6	3.5	6.1
1959	1.7	2.5	2.6	3.8	0.3	13.7	2.9	5.7
1960	1.7	2.3	2.5	3.7	0.3	14.9	3.1	6.7
1961	1.5	2.3	2.4	3.8	0.4	15.5	3.3	6.6
1962	1.4	2.2	2.4	3.7	0.3	14.4	3.0	6.4
1963	1.3	2.1	2.4	3.7	0.3	14.4	3.5	7.1
1980	1.0	1.5	2.0	3.0	0.4	12.5	5.5	8.0

4-24879

Exhibit 2. - Land use: Distribution of land area by states and land resource areas, by major land uses, Red River Basin Study Area, 1962

State and land resource area	Cropland	Pasture range	Forest woodland	Other land	Total inventoried
	thousand acres				
Arkansas					
86	23.3	48.4	31.8	.5	104.0
131	129.6	54.4	180.3	1.8	366.1
133	222.9	212.2	1,307.4	11.2	1,753.7
119	12.4	28.2	394.0	2.3	436.9
Sub-total	388.2	343.2	1,913.5	15.8	2,660.7
Louisiana					
131	453.7	397.0	813.5	44.8	1,709.0
133	100.6	330.3	2,235.9	141.8	2,808.6
134	19.8	38.7	50.0	1.6	110.1
Sub-total	574.1	766.0	3,099.4	188.2	4,627.7
Oklahoma					
131	63.9	42.0	44.4	1.9	152.2
112	71.8	193.5	119.5	61.2	446.0
84	13.6	21.9	99.7	23.9	159.1
133	259.0	218.6	610.1	30.7	1,118.4
85	164.5	337.0	157.8	40.0	699.3
119	44.1	119.2	2,042.9	81.0	2,287.2
80	16.1	-	.3	1.2	17.6
Sub-total	633.0	932.2	3,074.7	239.9	4,879.8
Texas					
86	942.5	443.0	269.6	26.7	1,681.8
131	70.8	37.6	66.1	.1	174.6
133	767.6	622.7	1,849.9	17.9	3,258.1
84	12.9	16.2	13.2	8.3	50.6
Sub-total	1,793.8	1,119.5	2,198.8	53.0	5,165.1
Basin total	3,389.1	3,160.9	10,286.4	496.9	17,333.3

Source: CNI 1958, with adjustment to the Red River Basin memo of June 30, 1965. "1962" data represent changes in large water areas and non-inventory acreages.

4-24879

Exhibit 3. - Land use: Distribution of land by major land uses and states by land resource area groupings, Red River Basin Study Area, 1962

Land use and states	Land Resource Areas					Total
	86	131,134	112,85	133,84,80	119	
	thousand acres					
Cropland						
Arkansas	23.3	129.6	-	222.9	12.4	388.2
Louisiana	-	473.5	-	100.6	-	574.1
Oklahoma	-	63.9	236.3	288.7	44.1	633.0
Texas	942.5	70.8	-	780.5	-	1,793.8
Sub-total	965.8	737.8	236.3	1,392.7	56.5	3,389.1
Pasture range						
Arkansas	48.4	54.4	-	212.2	28.2	343.2
Louisiana	-	435.7	-	330.3	-	766.0
Oklahoma	-	42.0	530.5	240.5	119.2	932.2
Texas	443.0	37.6	-	638.9	-	1,119.5
Sub-total	491.4	569.7	530.5	1,421.9	147.4	3,160.9
Forest woodland						
Arkansas	31.8	180.3	-	1,307.4	394.0	1,913.5
Louisiana	-	863.5	-	2,235.9	-	3,099.4
Oklahoma	-	44.4	277.3	710.1	2,042.9	3,074.7
Texas	269.6	66.1	-	1,863.1	-	2,198.8
Sub-total	301.4	1,154.3	277.3	6,116.5	2,436.9	10,286.4
Other						
Arkansas	0.5	1.8	-	11.2	2.3	15.8
Louisiana	-	46.4	-	141.8	-	188.2
Oklahoma	-	1.9	101.2	55.8	81.0	239.9
Texas	26.7	0.1	-	26.2	-	53.0
Sub-total	27.2	50.2	101.2	235.0	83.3	496.9
Basin total	1,785.8	2,512.0	1,145.3	9,166.1	2,724.1	17,333.3

Source: CNI 1958 with adjustments to the Red River Basin memo of June 30, 1965. "1962" data represent changes in large water areas and non-inventory acreages.

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Exhibit 4. - Population: Total, United States, Four-State Region 1/, and Red River Basin, 1940, 1950, 1960, and projected 1980 to 2080

Year	United States	Four-State Region 1/	Percent of U.S.	Red River Basin	Percent of U.S.	Red River Basin portion of: Arkansas 2/	Louisiana 3/	Oklahoma 4/	Texas 5/
	- - thousands - -		percent	thousands	percent	- - -	- thousands -	- - -	- - -
1940	132,600	13,064	9.9	1,885.0	1.42	194.8	717.9	364.8	607.5
1950	152,271	14,538	9.6	1,739.0	1.14	166.0	746.0	274.2	552.8
1960	180,676	16,951	9.4	1,704.2	0.94	141.7	824.3	224.3	513.9
1980	245,313	23,476	9.6	2,236.7	0.91	186.1	1,137.9	254.1	658.6
2000	338,219	32,459	9.6	2,948.1	0.87	244.7	1,571.1	287.7	844.6
2020	469,126	45,053	9.6	3,898.1	0.83	321.5	2,168.3	325.8	1,082.5
2040	647,394	62,533	9.6	5,172.7	0.80	422.5	2,993.2	369.1	1,387.9
2060	893,404	85,767	9.6	6,884.9	0.77	555.2	4,131.6	418.2	1,779.9
2080	1,232,900	118,358	9.6	9,188.1	0.74	729.5	5,703.5	473.7	2,281.4

1/ Four-State Region: Arkansas, Louisiana, Oklahoma, Texas
2/ Total population for 9 counties, RRB of Arkansas
3/ Total population for 20 parishes, RRB of Louisiana
4/ Total population for 13 counties, RRB of Oklahoma
5/ Total population for 19 counties, RRB of Texas

Source: Series B Census of Population, U. S. Department of Commerce; U. S. Corps of Engineers, New Orleans District population projection study by basins (March 1966)

4-24879

Exhibit 5 - Projected Land Utilization: Land in Farms, Major Agricultural Use with Crop Distribution, by Major Land Resource Area Groupings, Without Project Development Red River Basin Study Area, Projected 1980

Land Use	LRA 86	LRA 131 134	LRA 85,112	LRA 80,133	LRA 119	Total
	- - - - - - - - thousand acres - - - - - - - - - -					
Total cropland:	831.2	672.6	201.7	1,162.1	47.2	2,864.8
Cotton	147.5	74.5	7.1	13.1	-	232.2
Corn, silage	1.8	4.6	0.1	5.2	0.4	12.1
Corn, grain	20.5	15.0	2.6	7.8	Z	45.9
Oats	45.0	5.9	5.0	2.2	-	58.1
Barley	19.5	-	-	-	-	19.5
Sorghum, silage	10.3	0.4	2.5	6.0	0.1	19.3
Sorghum, grain	45.9	1.0	13.0	13.7	0.1	73.7
Wheat	96.2	3.0	2.9	0.3	-	102.4
Rice	-	5.5	-	-	-	5.5
Soybeans, forage	6.7	38.0	0.2	1.5	-	46.4
Soybeans, beans	3.9	44.9	2.3	0.6	-	51.7
Peanuts	11.0	Z	12.4	4.6	-	28.0
Sweet Potatoes	Z	14.7	Z	5.3	-	20.0
Vegetables	0.7	2.6	0.4	17.9	-	21.6
Cowpeas	0.4	Z	0.1	2.3	-	2.8
Sugarcane/sugar	-	1.0	-	-	-	1.0
Field seed crops (other)	31.6	1.4	0.7	1.3	-	35.0
Alfalfa	18.7	10.4	10.6	5.9	-	45.6
Other hay	101.5	135.9	40.5	236.7	20.8	535.4
Fruit, non-citrus.	1.9	6.8	0.8	5.3	-	14.8
Other	0.5	3.6	0.3	0.6	0.1	5.1
Not harvested: idle, fallow, etc.	38.1	64.8	27.2	146.2	3.2	279.5
Pastured	229.5	198.6	73.0	685.6	22.5	1,209.2
Pasture-Range:	653.4	640.6	598.2	1,227.0	148.9	3,268.1
Forest-Woodland:	261.7	1,173.6	239.3	6,529.3	2,500.0	10,703.9
Grazed	212.0	610.3	217.8	4,309.3	1,625.0	6,974.4
Not grazed	49.7	563.3	21.5	2,220.0	875.0	3,729.5
Other land:	30.9	63.3	100.4	203.8	14.6	413.0
Total land in farms	1,777.2	2,560.1	1,139.6	9,122.2	2,710.7	17,249.8

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Exhibit 6 - Projected Land Utilization: Land in Farms, Major Agricultural Use with Crop Distribution, by Major Land Resource Area Grouping Without Project Development, Red River Basin Study Area, Projected 2010

Land Use	LRA 86	LRA 131, 134	LRA 85, 112	LRA 80, 84, 133	LRA 119	Total
	thousand acres					
Total cropland:	795.1	592.3	193.4	1,108.0	45.7	2,734.5
Cotton	77.4	30.2	4.6	Z	-	112.2
Corn, silage	0.7	3.0	0.1	1.8	-	5.6
Corn, grain	6.7	16.0	0.9	2.6	-	26.2
Oats	48.1	7.8	5.5	1.6	-	63.0
Barley	21.0	-	-	-	-	21.0
Sorghum, silage	4.0	0.5	2.6	3.0	0.1	10.2
Sorghum, grain	61.0	2.8	13.5	8.0	0.1	85.4
Wheat	106.5	4.0	3.4	-	-	113.9
Rice	-	5.0	-	-	-	5.0
Soybeans, forage	7.1	6.8	0.3	1.8	-	16.0
Soybeans, beans	4.3	78.2	2.7	0.8	-	86.0
Peanuts	5.9	Z	10.6	3.0	-	19.5
Sweet Potatoes	-	14.3	-	2.6	-	16.9
Vegetables	0.7	2.6	0.4	17.7	-	21.4
Cowpeas	Z	-	-	-	-	-
Sugarcane/sugar	-	1.0	-	-	-	1.0
Field seed crops (other)	32.4	1.4	0.7	1.3	-	35.8
Alfalfa	19.5	14.0	10.5	6.2	-	50.2
Other hay	110.8	155.6	44.0	255.6	22.2	588.2
Fruit, non-citrus	1.9	6.8	0.8	5.3	0.2	15.0
Other	0.6	4.0	0.3	0.3	0.1	5.3
Not harvested: idle, fallow, etc	25.1	65.6	26.8	125.0	3.3	245.8
Pastured	261.4	172.7	65.7	671.4	19.7	1,190.9
Pasture-Range	664.2	645.1	611.4	1,323.7	167.1	3,411.5
Forest-Woodland:	249.5	1,112.9	231.8	6,214.9	2,436.7	10,245.8
Grazed	202.1	578.7	210.9	4,101.8	1,583.9	6,677.4
Not grazed	47.4	534.2	20.9	2,113.1	852.8	3,568.4
Other land:	48.1	99.7	101.2	355.3	55.6	659.9
Total land in farms	1,756.9	2,450.0	1,137.8	9,001.9	2,705.1	17,051.7

4-24879

Exhibit 7 - Land Utilization: Land in Farms, Major Agricultural Use with Crop Distribution, by Major Land Resource Area Grouping Without Project Development, Red River Basin, Extrapolated 2080

Land Use	LRA 86	LRA 131, 134	LRA 85, 112	LRA 80, 84, 133	LRA 119	Total
	thousand acres					
Total cropland:	940.9	668.7	196.9	1,075.5	51.0	2,933.0
Cotton	38.7	30.0	5.0	-	-	73.7
Corn, silage	0.8	4.4	0.6	2.9	-	8.7
Corn, grain	7.6	23.2	5.5	-	-	36.3
Oats	55.3	12.4	6.9	2.0	-	76.6
Barley	24.5	-	-	-	-	24.5
Sorghum, silage	4.0	0.5	2.8	3.0	1.7	12.0
Sorghum, grain	96.2	8.4	14.9	10.0	0.1	129.6
Wheat	142.0	5.1	4.5	-	-	151.6
Rice	-	5.0	-	-	-	5.0
Soybeans, forage	8.0	19.5	0.4	3.4	-	31.3
Soybeans, beans	7.5	155.9	3.7	1.5	-	168.6
Peanuts	5.9	-	10.6	3.0	-	19.5
Sweet potatoes	-	14.3	-	2.6	-	16.9
Vegetables	0.7	2.6	0.4	17.7	-	21.4
Sugarcane/sugar	-	1.0	-	-	-	1.0
Field seed crops (other)	33.9	1.4	0.7	1.3	-	37.3
Alfalfa	22.0	26.9	13.0	9.1		71.0
Other hay	132.5	20[illegible].6	52.2	299.6	25.[illegible]	711.3
Fruit, non-citrus	1.9	6.8	0.8	5.3	0.7	15.5
Other	0.6	4.5	0.3	0.3	0.1	5.8
Not harvested: idle, fallow, etc	23.0	39.5	25.9	75.5	3.3	167.2
Pastured	335.8	105.7	48.7	638.3	19.7	1,148.2
Pasture-Range:	665.0	645.1	634.0	1,323.7	167.1	3,434.9
Forest-Woodland:	221.0	971.3	214.3	5,481.3	2,289.0	9,176.9
Grazed	179.0	505.0	194.8	3,617.6	1,486.9	5,983.3
Not grazed	42.0	466.3	19.5	1,863.7	802.1	3,193.6
Other land:	51.1	105.7	107.1	376.8	59.5	700.2
Total land in farms	1,878.0	2,390.8	1,152.3	8,257.3	2,566.6	16,245.0

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Exhibit 8 -- Yields: Major crops and pasture, Red River Basin Study Area, 1962, projected 1980, 2010, extrapolated 2080

Crop and pasture	Unit	Study area average				Land Resource Area 86				Land Resource Area 131,134			
		1962	1980	2010	2080	1962	1980	2010	2080	1962	1980	2010	2080
Cotton	lbs.	422	603	870	1,508	390	590	830	1,400	560	705	1,020	1,750
Feed grains:													
Corn	bu.	31	50	63	88	30	49	55	69	35	58	68	91
Oats	bu.	26	30	36	48	25	29	34	45	35	37	42	54
Barley	bu.	21	24	27	34	21	24	27	34	--	--	--	--
Sorghum	bu.	31	39	48	71	32	39	49	74	32	51	57	73
Wheat	bu.	23	25	28	36	23	25	27	35	21	28	38	60
Rice	lbs.	3,250	4,640	6,120	7,640	--	--	--	--	3,250	4,640	6,120	7,640
Soybeans	bu.	22	27	41	75	24	27	30	38	22	27	42	77
Peanuts	lbs.	753	850	1,170	1,802	720	810	950	1,090	--	--	--	--
Sweet potatoes	bu.	115	118	130	185	--	--	--	--	87	91	100	121
Vegetables	cwt.	65	69	92	131	53	58	62	72	62	74	88	120
Alfalfa & mixture	ton	2.1	2.6	3.3	4.9	1.8	2.4	3.0	4.4	2.3	2.7	3.8	6.0
Other hay	ton	1.3	1.6	2.2	3.4	1.2	1.4	1.6	2.1	1.5	1.7	2.2	3.5
Sugar cane for sugar	ton	19	27	33	47	--	--	--	--	19	27	33	47
Fruit, non-citrus	ton	0.6	0.8	0.9	1.4	0.6	0.8	0.9	1.4	0.6	0.8	0.9	1.1
Pasture & range	AUM	4.4	5.2	5.7	7.1	5.0	5.7	6.3	7.7	5.8	6.7	7.4	9.0
Woodland pastured	AUM	0.3	0.3	0.3	0.3	0.6	0.6	0.6	0.6	0.3	0.3	0.3	0.3
Cropland pastured	AUM	5.3	6.1	7.5	10.6	6.5	7.6	9.2	12.9	7.0	8.2	10.0	14.2

Exhibit 8 -- Continued

Crop and pasture	Unit	Land Resource Area 85, 112				Land Resource Area 80, 84, 133				Land Resource Area 119			
		1962	1980	2010	2080	1962	1980	2010	2080	1962	1980	2010	2080
Cotton	lbs.	210	350	510	900	275	425	--	--	--	--	--	--
Feed grains:													
Corn	bu.	36	40	48	67	28	34	54	68	26	--	--	--
Oats	bu.	22	28	38	62	24	27	32	44	--	--	--	--
Barley	bu.	23	--	--	--	--	--	--	--	--	--	--	--
Sorghum	bu.	29	35	41	55	30	40	49	70	32	40	49	70
Wheat	bu.	25	27	29	34	20	25	--	--	--	--	--	--
Rice	lb.	--	--	--	--	--	--	--	--	--	--	--	--
Soybeans	bu.	22	30	39	61	18	28	37	58	--	--	--	--
Peanuts	lb.	800	940	1,320	2,207	585	740	1,050	1,770	--	--	--	--
Sweet potatoes	bu.	--	--	--	--	168	197	300	540	--	--	--	--
Vegetables	cwt.	63	72	84	112	77	88	102	135	Z	Z	Z	Z
Alfalfa & mixture	ton	2.6	2.7	3.0	4.0	2.4	2.6	3.1	4.3	--	--	--	--
Other hay	ton	1.3	1.7	2.3	3.6	1.3	1.7	2.4	4.0	1.0	1.1	1.4	2.1
Sugar cane for sugar	ton	--	--	--	--	--	--	--	--	--	--	--	--
Fruit, non-citrus	ton	0.6	0.8	0.9	1.1	1.1	1.3	1.6	2.5	0.2	0.2	0.2	0.2
Pasture & range	AUM	4.4	5.0	5.6	7.0	3.9	4.5	5.0	6.2	3.0	3.4	3.8	4.7
Woodland pastured	AUM	0.5	0.5	0.5	0.5	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2
Cropland pastured	AUM	4.6	5.4	6.6	9.4	4.5	5.2	6.3	8.9	4.1	4.8	5.8	8.1

Z - Small quantities, or insignificant.

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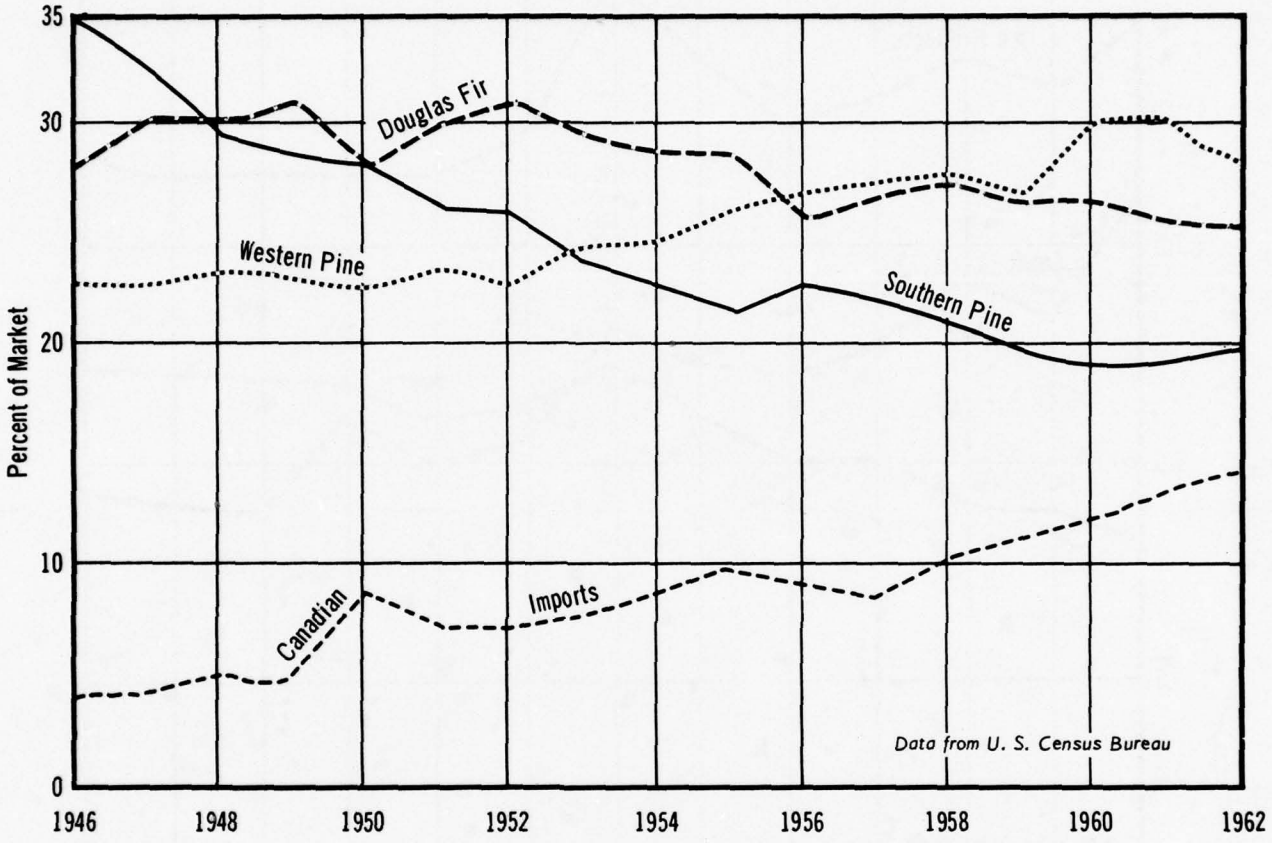

Exhibit 9

REGIONAL COMPETITION FOR SOFTWOOD LUMBER MARKET

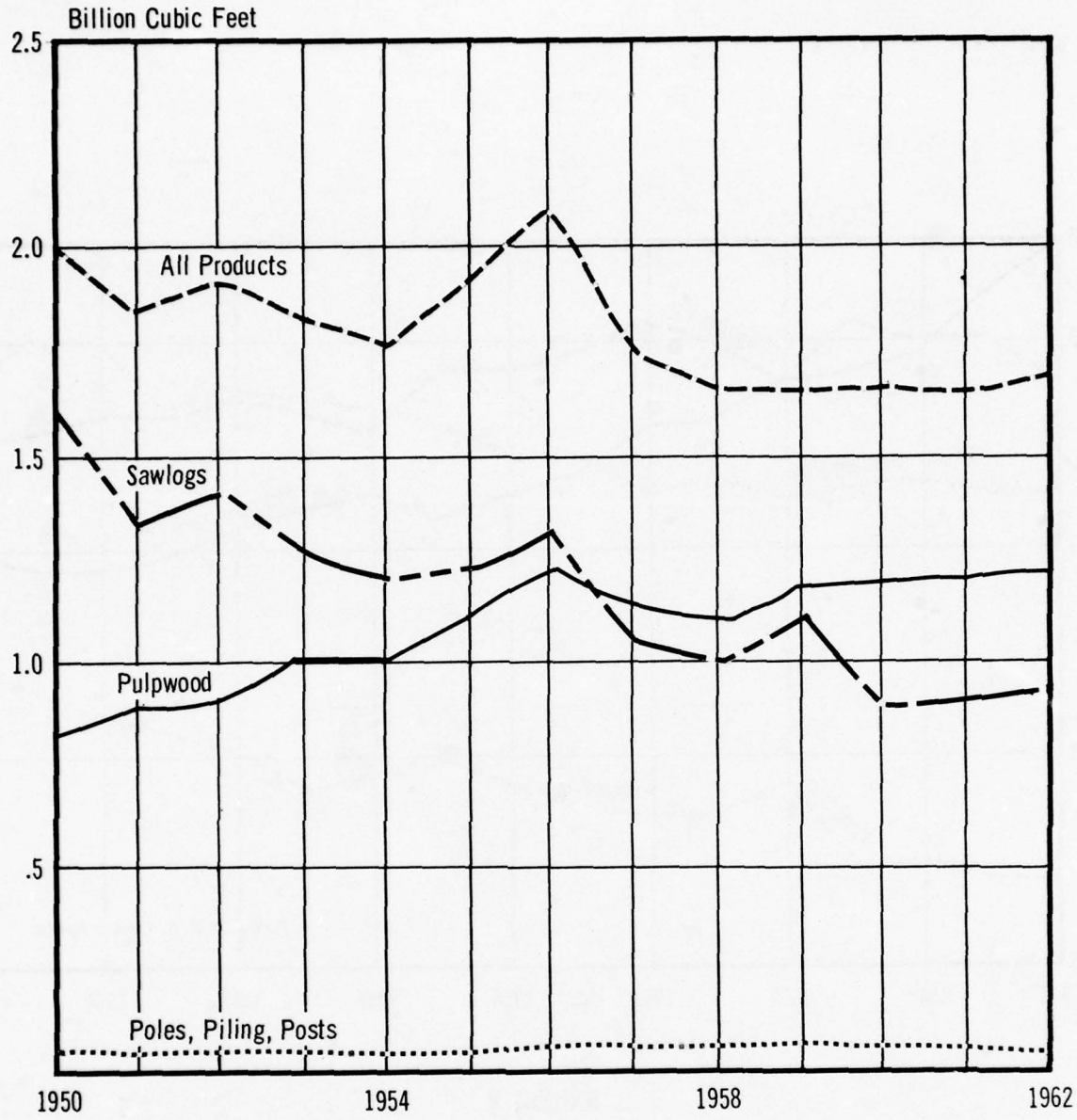

Exhibit 10

THE CHANGING DEMAND FOR SOUTHERN PINE

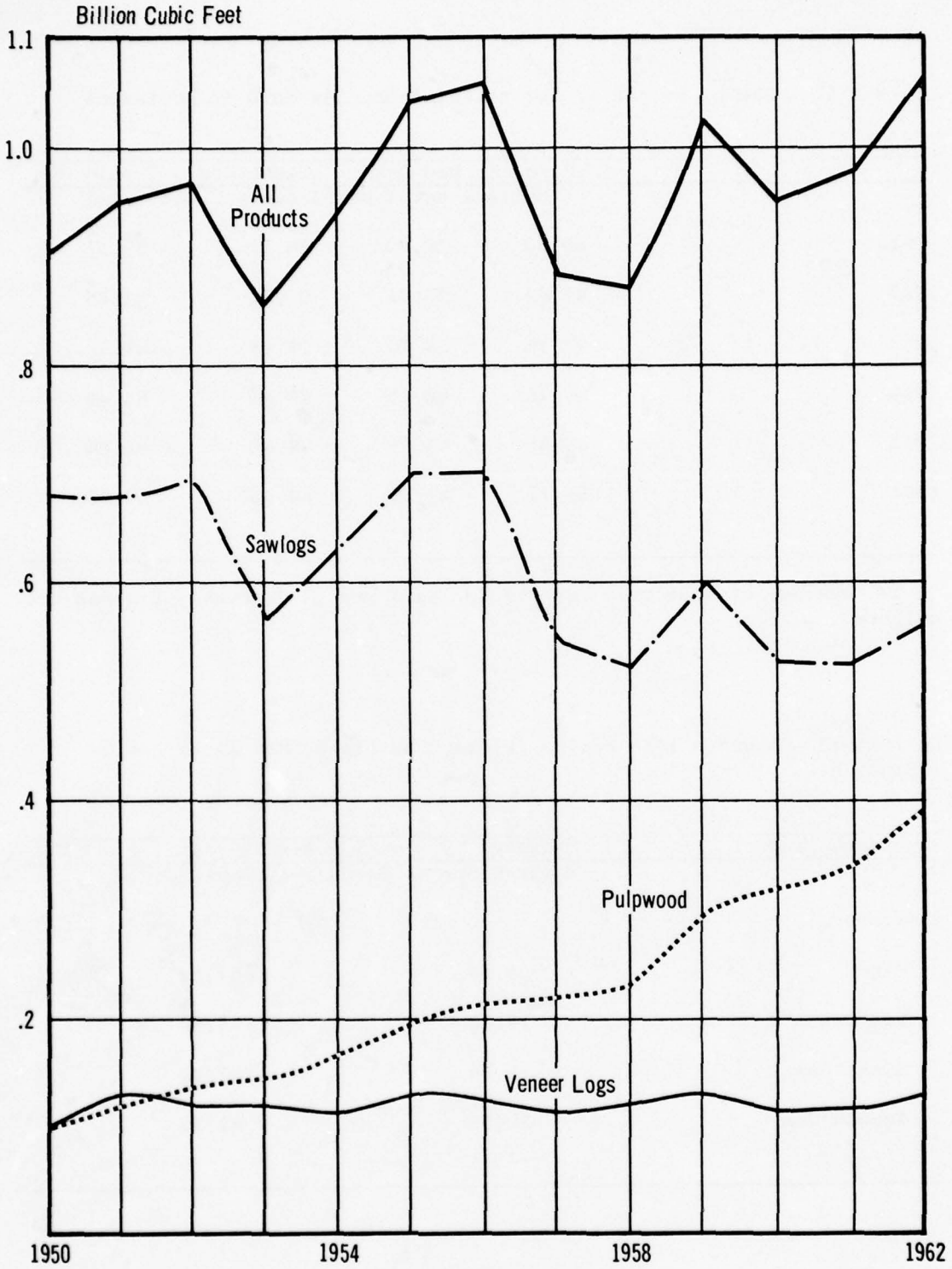

Exhibit II

THE CHANGING DEMAND FOR SOUTHERN HARDWOOD

4-24879

Exhibit 12 - Sawlog Prices 1/ for selected Species Sold in Louisiana

Year	Pine	Red Oak	Sweet Gum	Tupelo Gum
	dollars per M board feet, f.o.b. mill			
1961	48.80	37.80	38.27	39.51
1962	47.82	38.91	39.11	41.85
1963	47.59	38.70	39.08	41.32
1964	48.18	40.25	43.40	43.44
1965	49.45	43.99	44.00	46.84
1966	55.75	47.50	49.00	50.50

1/ Average of quarterly reports for each year. Quarterly figures are weighted.

Exhibit 13 - Average 1966 Sawlog Prices, Louisiana, Red River Basin Study Area

Species & Product	Stumpage	Local Delivery Point, f.o.b.
	dollars per M board feet, Doyle Scale	
Sawtimber		
Pine	35.56	57.62
Red Oak	19.10	45.90
Sweet Gum	19.78	47.70
Tupelo Gum	20.50	49.75

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Exhibit 14 - Wholesale Price Indexes for Southern Pine Lumber, U. S. Average, Red River Basin Study Area

Year	Normal : All Lumber	Price : Number One Dimension	Index : Number Two Boards
(1957-59 average = 100.0)	------	index	----------
1961	95.8	99.7	92.7
1962	95.7	99.3	93.1
1963	95.4	99.1	92.5
1964	95.5	99.8	92.7
1965	97.2	100.9	94.3
1966	106.3*	108.8*	104.6*

* Only eight months of data available

Exhibit 15 - Wholesale Price Indexes for Hardwood Lumber of Selected Species, U. S. Average, Red River Basin Study Area

Year	All hard- : wood lumber	Select, red : oak, flooring	Number one : common gum
(1957-59 average = 100.0)	---------	index	----------
1961	98.5	99.1	93.4
1962	98.3	95.1	105.0
1963	101.5	101.5	110.0
1964	105.4	109.2	109.4
1965	111.3	114.8	117.8
1966	125.1*	135.0*	146.0*

* Only eight months of data available

4-24879

Exhibit 16 - Watershed Area and Floodplain Land Use for CNI Watersheds Authorized for Operations, December 31, 1962, Red River Basin Study Area

Tributary Basin and CNI Watershed	Watershed Area	Cropland	Pastureland	Woodland	Miscellaneous	Total
			acres			
Intervening Areas - Texas						
3-21	46,784	1,310	1,542	965	40	3,857
Total	46,784	1,310	1,542	965	40	3,857
Intervening Areas - Arkansas & Oklahoma						
3-36	29,575	2,388	1,498	1,437	204	5,527
Total	29,575	2,388	1,498	1,437	204	5,527
Blue River						
3-23a	203,100	10,682	5,826	2,525	388	19,421
Total	203,100	10,682	5,826	2,525	388	19,421
Boggy Creek						
3h1-4	50,016	1,538	1,691	987	87	4,303
3h1-5	107,968	3,079	3,453	3,548	48	10,128
3h1-6	162,240	3,473	4,340	4,342	248	12,403
3h2-5	23,571	12	913	205	12	1,142
Total	343,795	8,102	10,397	9,082	395	27,976
Sulphur River						
3k-8	25,000	780	1,490	110	70	2,450
3k-13	31,400	1,800	1,220	0	90	3,110
Total	56,400	2,580	2,710	110	160	5,560
Loggy Bayou						
3m2-4	5,550	228	431	35	185	879
Total	5,550	228	431	35	185	879
Bayou Pierre						
3n-3	57,610	3,779	2,358	1,908	61	8,106
Total	57,610	3,779	2,358	1,908	61	8,106
Bayou Jean de Jean						
3-68	58,494	55	220	4,915	270	5,460
and Bayou Rapides						
10-17	40,406	10	38	864	48	960
Total	98,900	65	258	5,779	318	6,420
Grand Total	**841,714**	**29,134**	**25,020**	**21,841**	**1,751**	**77,746**

4-24879

Exhibit 17 - Floodplain Land Use, Watersheds Considered Feasible for Development Within 10-15 Years, Red River Basin Study Area

Tributary Basin and CNI Watershed	Watershed Area	Cropland	Pastureland	Woodland	Miscellaneous	Total 1/
			- acres -			
Intervening Areas - Texas						
3-19	168,000	7,493	3,458	461	115	11,527
3-25	133,363	3,719	3,828	5,778	75	13,400
3-25a	142,438	6,882	3,144	2,874	130	13,030
3-27	7,334	2,000	1,040	980	50	4,070
3-29	14,569	6,130	2,630	1,890	535	11,185
3-33	119,040	2,580	5,160	4,770	390	12,900
Total	584,744	28,804	19,260	16,753	1,295	66,112
Intervening Areas - Arkansas & Oklahoma						
3-35	16,621	1,765	3,239	2,144	72	7,220
3-39	43,410	8,717	18,062	0	1,676	28,455
3-40	55,324	3,175	6,460	0	615	10,250
3-41	57,483	2,245	5,560	5,310	180	13,295
3-46	15,380	1,018	2,411	1,907	169	5,505
Total	188,218	16,920	35,732	9,361	2,712	64,725
Blue River						
3-23	230,651	1,800	6,264	9,686	90	17,840
Total	230,651	1,800	6,264	9,686	90	17,840
Boggy Creek						
3h1-2	240,301	3,956	8,109	8,094	284	20,443
3h1-3	30,541	422	1,327	428	45	2,222
3h2-4	144,253	1,200	3,600	7,080	120	12,000
3h2-6	206,230	3,230	6,800	6,800	170	17,000
Total	621,325	8,808	19,836	22,402	619	51,665
Kiamichi River						
3i-2	9,171	1,935	728	917	70	3,650
3i-4	39,674	239	1,163	1,551	30	2,983
3i-8	37,997	212	1,474	1,129	30	2,845
Total	86,842	2,386	3,365	3,597	130	9,478
Barkman Creek						
3-47	2,667	725	500	430	45	1,700
3-48	44,033	2,782	1,940	1,602	166	6,490
Total	46,700	3,507	2,440	2,032	211	8,190

Continued ---

4-24879

Exhibit 17 - Floodplain Land Use, Watersheds Considered Feasible for Development Within 10-15 Years, Red River Basin Study Area--Continued

Tributary Basin and CNI Watershed	Watershed Area	Cropland	Pastureland	Woodland	Miscellaneous	Total 1/
			acres			
Little River						
3j-4	94,106	1,863	2,645	1,262	240	6,010
Total	94,106	1,863	2,645	1,262	240	6,010
McKinney Bayou						
3-52	125,308	5,850	7,915	13,835	300	27,900
3-53	55,222	7,950	14,950	7,500	550	30,950
3-54	28,866	7,170	4,985	6,215	270	18,640
Total	209,396	20,970	27,850	27,550	1,120	77,490
Sulphur River						
3k-9	62,720	570	1,460	1,285	105	3,420
3k-11	3,840	0	180	0	20	200
3k-12	19,200	94	698	300	10	1,102
3k-14	204,600	775	3,688	1,597	54	6,114
3k-17	135,040	987	5,077	5,428	0	11,492
3k-18	77,440	393	3,846	3,033	0	7,272
Total	502,840	2,819	14,949	11,643	189	29,600
Posten Bayou						
3-57	61,306	9,460	2,740	3,520	280	16,000
Total	61,306	9,460	2,740	3,520	280	16,000
Red River Main Stem						
3-60	24,090	3,700	2,600	2,700	0	9,000
Total	24,090	3,700	2,600	2,700	0	9,000
Loggy Bayou						
3m-1	8,600	0	445	222	0	667
3m1-2	89,700	59	1,904	7,051	99	9,913
3m2-3	148,500	19,590	8,119	2,991	6,550	37,250
Total	246,800	19,649	10,468	11,064	6,649	47,830
Bayou Pierre						
3n-2	92,199	1,945	1,040	4,695	0	7,680
Total	92,199	1,945	1,040	4,695	0	7,680
Cane River						
3-64	104,181	216	3,308	8,308	113	11,945
3-65	242,116	479	11,322	22,113	306	34,220
3-66	103,456	131	6,313	11,857	159	18,460
Total	449,753	826	20,943	42,278	578	64,625

Continued ---

4-24879

Exhibit 17 - Floodplain Land Use, Watersheds Considered Feasible for Development Within 10-15 Years, Red River Basin Study Area--Continued

Tributary Basin and CNI Watershed	Watershed Area	Cropland	Pastureland	Woodland	Miscellaneous	Total [1]
	- - - - - - - acres - - - - - - -					
Bayou Rigolette						
3-69	20,180	1,486	4,256	5,283	665	11,690
3-70	247,190	4,649	13,501	18,325	842	37,317
Total	267,370	6,135	17,757	23,608	1,507	49,007
Red River Backwater						
3-73	38,886	5,550	1,612	24,817	795	32,774
3-75	111,025	14,123	4,571	87,941	2,076	108,711
3-76	23,617	475	1,890	21,017	235	23,617
Total	173,528	20,148	8,073	133,775	3,106	165,102
Chatlin Lake & Associated Area						
10-11 & 12	66,157	11,620	2,580	500	1,100	15,800 [2]
10-15	118,087	26,653	25,017	19,425	4,000	75,095
10-10	108,368	32,800	15,530	54,620	5,418	108,368
10-13	156,338	43,600	44,315	49,800	5,285	143,000
10-14	84,200	17,410	6,900	16,990	12,400	53,700
10-16	45,819	20,057	8,054	5,168	12,540	45,819
Total	578,969	152,140	102,396	146,503	40,743	441,782
Grand Total	4,458,837	301,880	298,358	472,429	59,469	1,132,136

1/ Potential benefit area
2/ Includes Watershed 10-12

4-24879

Exhibit 18 - Floodplain Land Use, Watersheds Considered Potentially Feasible for Development After 10-15 Years, Red River Basin Study Area

Tributary Basin and CNI Watershed:	Watershed Area	Cropland	Pasture-land	Woodland	Miscel-laneous	Total
			acres			
Intervening Areas - Texas						
3-30	117,624	1,025	2,050	6,550	615	10,240
Total	117,624	1,025	2,050	6,550	615	10,240
Intervening Areas - Arkansas and Oklahoma						
3-22	213,576	2,319	5,227	25,536	268	33,350
3-26	72,351	587	2,541	2,137	40	5,305
Total	285,927	2,906	7,768	27,673	308	38,655
Little River						
3j-2	74,444	1,680	2,210	19,010	80	22,980
Total	74,444	1,680	2,210	19,010	80	22,980
Sulphur River						
3k-15	9,600	195	750	540	15	1,500
Total	9,600	195	750	540	15	1,500
Posten Bayou						
3-57a	27,744	2,630	1,000	1,000	145	4,775
Total	27,744	2,630	1,000	1,000	145	4,775
Grand Total	515,339	8,436	13,778	54,773	1,163	78,150

4-24879

Exhibit 19 - Floodplain Land Use, Watersheds Considered not Feasible for Development, Red River Basin Study Area

Tributary Basin and CNI Watershed	Watershed Area	Cropland	Pasture-land	Woodland	Miscel-laneous	Total
			acres			
Intervening Areas - Texas						
3-20	21,572	100	260	1,500	40	1,900
3-24	72,589	5,970	5,180	4,240	310	15,700
3-18	22,467	1,200	2,750	20,260	490	24,700
3-27a & 3-28	31,901	1,500	2,400	11,610	160	15,670
3-31	8,684	480	600	2,980	40	4,100
3-38	160,515	925	9,210	20,550	305	30,990
3-42	244,012	8,800	17,000	28,000	1,100	54,900
3-44	41,881	1,730	1,730	13,490	350	17,300
Total	603,621	20,705	39,130	102,630	2,795	165,260
Intervening Areas - Arkansas & Oklahoma						
3-32	74,363	90	797	905	18	1,810
3-34	45,631	94	925	814	17	1,850
3-37	23,654	125	418	552	10	1,105
3-43	44,697	1,380	2,735	1,985	220	6,320
3-45	53,086	96	877	606	16	1,595
3-49	14,220	2	66	60	2	130
Total	255,651	1,787	5,818	4,922	283	12,810
Boggy Creek						
3h-1	127,130	285	4,240	23,490	285	28,300
3h1-1	45,855	120	2,400	9,360	120	12,000
3h2-1	148,015	2,980	6,655	13,075	230	22,940
3h2-2	111,854	0	40	744	16	800
3h2-3	148,643	76	1,140	2,546	38	3,800
Total	581,497	3,461	14,475	49,215	689	67,840
Kiamichi River						
3i-1	281,448	385	1,930	6,845	480	9,640
3i-3	142,977	250	1,500	4,438	62	6,250
3i-5	254,778	360	2,410	9,160	120	12,050
3i-6 & 3i-9	178,483	600	3,750	10,500	150	15,000
3i-7	232,395	360	1,790	4,940	70	7,160
Total	1,090,081	1,955	11,380	35,883	882	50,100

Continued ---

4-24879

Exhibit 19 - Floodplain Land Use, Watersheds Considered not Feasible for Development, Red River Basin Study Area--Continued

Tributary Basin: and CNI Watershed	Watershed Area	Cropland	Pasture-land	Woodland	Miscel-laneous	Total
			acres			
Little River						
3j-1	38,710	1,220	785	14,995	0	17,000
3j-3	47,539	155	550	3,080	115	3,900
3j-5	53,696	590	1,880	9,440	40	11,950
3j-6	84,857	480	2,255	9,410	80	12,225
3j-7	85,754	430	1,005	5,690	35	7,160
3j-8	55,795	180	890	3,335	45	4,450
3j-9	84,413	580	3,175	7,275	40	11,070
3j-10	63,713	560	2,985	7,125	0	10,670
3j-11	83,642	240	1,395	4,990	65	6,690
3j-12	43,246	15	135	1,500	20	1,670
3j-13	93,157	35	250	3,325	0	3,610
3j-14	117,365	1,290	3,445	23,065	120	27,920
3j-15	122,753	454	2,266	12,250	70	15,040
3j-16	110,449	121	819	5,250	45	6,235
3j-17	199,602	760	2,930	34,410	70	38,170
3j-18	31,639	320	1,568	1,280	32	3,200
3j-19	217,693	420	1,570	10,110	70	12,170
3j-20	264,253	540	3,060	8,180	50	11,830
3j-21	205,021	40	330	3,690	40	4,100
3j1-1	231,525	1,200	2,400	8,660	40	12,300
3j1-2	166,569	70	580	6,480	70	7,200
3j1-3	22,500	9	135	836	5	985
3j1-4	77,153	30	250	2,790	30	3,100
3j1-5	38,027	15	120	1,350	15	1,500
Total	2,539,071	9,754	34,778	188,516	1,097	234,145
Bois d'Arc Creek						
3-50	92,012	93	4,704	2,842	76	7,715
3-51	62,096	105	3,835	1,260	50	5,250
Total	154,108	198	8,539	4,102	126	12,965
Maniece Bayou						
3-56	73,818	1,760	9,020	11,000	220	22,000
Total	73,818	1,760	9,020	11,000	220	22,000
McKinney Bayou						
3-55	36,692	2,145	2,275	10,170	30	14,620
Total	36,692	2,145	2,275	10,170	30	14,620

Continued ---

4-24879

Exhibit 19 - Floodplain Land Use, Watersheds Considered not Feasible for Development, Red River Basin Study Area -- Continued

Tributary Basin and CNI Watershed	Watershed Area	Cropland	Pasture-land	Woodland	Miscellaneous	Total
			acres			
Sulphur River						
3k-1	182,266	520	2,470	29,200	310	32,500
3k-2	158,224	0	240	5,160	600	6,000
3k-3	145,910	0	780	3,770	50	4,600
3k-4	247,040	140	700	6,090	70	7,000
3k-5	131,840	7,700	3,670	24,960	370	36,700
3k-6	177,920	2,430	12,540	22,065	305	37,340
3k-7	5,760	2,990	0	90	0	3,080
3k-10	175,400	2,070	12,385	7,605	470	22,530
3k-16	84,456	1,630	2,500	1,620	50	5,800
3kl-1	248,960	0	10,780	35,160	940	46,880
3kl-2	97,520	1,050	10,500	9,240	210	21,000 1/
3kl-2a	138,000	-	-	-	-	-
Total	1,793,296	18,530	56,565	144,960	3,375	223,430
Red River Main Stem						
3-58	37,086	2,000	7,700	8,475	200	18,375
3-59	39,900	3,850	13,900	14,235	350	32,335
3-61	77,342	5,990	18,850	13,900	960	39,700
3-62	35,572	730	1,650	3,760	100	6,240
3-71	92,729	4,752	16,111	24,060	4,542	49,465
Total	282,629	17,322	58,211	64,430	6,152	146,115
Cypress Creek						
3L-1	54,943	38,212	10,294	5,120	269	53,895
3L-2	195,500	8	2,602	12,086	244	14,940
3L-3	113,637	18,544	5,293	4,446	163	28,446
3L-4	133,298	0	1,020	9,073	88	10,181
3L-5	151,224	0	676	5,539	100	6,315
3L-6	124,164	30	1,299	5,277	69	6,675
3L-7	110,230	0	0	5,158	52	5,210
3L-8	89,307	0	1,048	5,873	69	6,990
3L1-1	247,080	0	4,400	22,825	275	27,500
3L1-2	248,000	79	4,384	11,317	160	15,940
3L1-3	241,350	0	3,088	16,019	193	19,300
3L1-4	106,640	0	0	17,523	177	17,700
3L1-5	243,440	479	4,785	10,527	159	15,950
3L1-6	249,230	688	6,880	9,460	172	17,200
Total	2,308,043	58,040	45,769	140,243	2,190	246,242

Continued ---

4-24879

Exhibit 19 - Floodplain Land Use, Watersheds Considered not Feasible for Development, Red River Basin Study Area--Continued

Tributary Basin and CNI Watershed	Watershed Area	Cropland	Pasture-land	Woodland	Miscel-laneous	Total
			acres			
Loggy Bayou						
3m-2	196,102	0	800	10,400	0	11,200
3m1-1	114,663	0	1,850	16,650	0	18,500
3m1-2	147,079	0	3,050	14,235	0	17,285
3m1-3	128,149	0	915	7,595	0	8,510
3m1-4	43,316	30	330	2,205	0	2,565
3m1-5	90,200	0	350	10,665	0	11,015
3m1-6	75,011	0	700	6,300	0	7,000
3m1-8	87,414	0	450	4,050	0	4,500
3m2-1	42,123	4,105	16,420	12,850	0	33,375
3m2(a)-1	158,978	0	1,000	24,365	0	25,365
3m2(a)-2	54,243	0	200	1,800	0	2,000
3m2(a)-3	27,229	0	160	2,700	0	2,860
3m2(a)-4	68,858	0	100	1,170	0	1,270
3m2(a)-5	57,745	0	300	2,700	0	3,000
3m2(a)-6	84,769	0	615	5,545	0	6,160
3m2(a)-7	66,926	0	310	5,400	0	5,710
3m2-2	21,520	1,550	4,650	6,600	0	12,800
Total	1,464,325	5,685	32,200	135,230	0	173,115
Bayou Pierre						
3n-1	147,329	70	1,385	5,405	70	6,930
3n-4	237,162	162	2,746	13,247	0	16,155
3n-5	228,520	0	3,520	12,420	0	15,940
Total	613,011	232	7,651	31,072	70	39,025
Black and Saline Lakes						
3o-1	30,374	1,580	4,070	8,900	160	14,710
3o-2	131,585	0	130	12,950	0	13,080
3o-3	135,355	0	370	14,000	0	14,370
3o1-1	76,761	185	1,220	5,255	40	6,700
3o1-2	111,320	0	290	9,340	0	9,630
3o1-3	187,234	0	720	20,700	0	21,420
3o1-4	215,980	0	2,200	21,640	0	23,840
Total	888,609	1,765	9,000	92,785	200	103,750
Nantachie Creek						
3-63	54,071	0	200	3,890	40	4,130
Total	54,071	0	200	3,890	40	4,130

Continued ---

4-24879

Exhibit 19 - Floodplain Land Use, Watersheds Considered not Feasible for Development, Red River Basin Study Area -- Continued

Tributary Basin and CNI Watershed	Watershed Area	Cropland	Pasture-land	Woodland	Miscellaneous	Total
			acres			
Cane River						
3-67	34,686	108	234	6,974	49	7,365
Total	34,686	108	234	6,974	49	7,365
Bayou Rapides						
10-18	12,573	0	0	0	0	0
Total	12,573	0	0	0	0	0
Red River Backwater						
3-72	80,590	0	5,000	30,943	0	35,943
3-74	65,747	0	-	63,173	0	63,173
3-77	14,403	4,000	1,500	50,000	2,000	57,500 2/
3-78	65,163	-	-	-	-	-
3-81	87,523	2,250	3,000	69,000	750	75,000
Total	313,426	6,250	9,500	213,116	2,750	231,616
Chatlin Lake and Associated Area						
10-6	9,991	950	1,100	5,200	80	7,330
10-19	9,583	0	0	0	0	0
Total	19,574	950	1,100	5,200	80	7,330
Grand Total	13,118,782	150,647	345,845	1,244,338	21,028	1,761,858

1/ Includes Watershed 3k1-2a
2/ Includes Watershed 3-78

4-24879

Exhibit 20 - Estimated Average Annual Flood Damages 1/, Watersheds Authorized for Construction, December 31, 1962, Red River Basin Study Area

Tributary Basin and CNI Watershed	Floodwater: Agricultural	Floodwater: Nonagricultural	Sediment	Erosion	Indirect	Total
			dollars			
Intervening Areas - Texas						
3-21	52,670	7,050	3,720	1,870	6,530	71,840
Total	52,670	7,050	3,720	1,870	6,530	71,840
Intervening Areas - Arkansas and Oklahoma						
3-36	140,790	23,250	1,490	4,270	16,980	186,780
Total	140,790	23,250	1,490	4,270	16,980	186,780
Blue River						
3-23a	191,440	7,170	36,290	24,380	25,920	285,200
Total	191,440	7,170	36,290	24,380	25,920	285,200
Boggy Creek						
3h1-5	162,880	31,630	4,480	19,630	21,860	240,480
3h1-6	190,640	35,840	7,300	41,580	27,530	302,890
3h2-5	7,230	1,330	1,330	1,550	610	12,050
3h1-4	29,630	1,500	3,430	12,120	5,000	51,680
Total	390,380	70,300	16,540	74,880	55,000	607,100
Sulphur River						
3k-8	32,980	6,090	2,840	380	4,280	46,570
3k-13	36,420	3,010	11,110	1,750	7,840	60,130
Total	69,400	9,100	13,950	2,130	12,120	106,700
Loggy Bayou						
3m2-4	9,660	29,400	630	320	3,990	44,000
Total	9,660	29,400	630	320	3,990	44,000
Bayou Pierre						
3n-3	57,750	0	940	8,610	6,720	74,020
Total	57,750	0	940	8,610	6,720	74,020
Bayou Jean de Jean and Bayou Rapides						
3-68 and 10-17	2,000	0	0	0	0	2,000
Total	2,000	0	0	0	0	2,000
Grand Total	914,090	146,270	73,560	116,460	127,260	1,377,640

1/ Adjusted normalized prices

4-24879

Exhibit 21 - Estimated Average Annual Flood Damages for Watersheds Considered Feasible for Development Within 10-15 Years, Red River Basin Study Area

Tributary Basin and CNI Watershed	Floodwater: Agricultural	Floodwater: Nonagricultural	Sediment	Erosion	Indirect	Total
	- - - - - - - dollars - - - - - - -					
Intervening Areas - Texas						
3-19	138,720	79,790	4,270	20,570	24,330	267,680
3-25	207,200	26,800	4,500	4,000	24,200	266,700
3-25a	294,100	63,800	1,600	5,300	36,500	401,300
3-27	0	0	2,570	0	260	2,830
3-29	82,540	0	210	0	0	82,750
3-33	215,420	6,740	10,680	210	17,140	250,190
Total	937,980	177,130	23,830	30,080	102,430	1,271,450
Intervening Areas - Arkansas and Oklahoma						
3-41	122,640	1,000	0	0	4,040	127,680
3-40	33,080	0	0	0	0	33,080
3-35	34,910	1,360	570	230	2,720	39,790
3-46	10,980	270	0	0	420	11,670
3-39	42,020	0	0	0	0	42,020
Total	243,630	2,630	570	230	7,180	254,240
Blue River						
3-23	201,780	40,790	6,080	20,020	26,870	295,540
Total	201,780	40,790	6,080	20,020	26,870	295,540
Boggy Creek						
3h2-6	113,820	26,770	12,090	20,050	17,270	190,000
3h2-4	56,700	10,080	7,870	11,760	8,610	95,020
3h1-2	116,440	2,600	25,210	14,920	15,920	175,090
3h1-3	11,250	1,840	1,590	6,840	1,980	23,500
Total	298,210	41,290	46,760	53,570	43,780	483,610
Kiamichi River						
3i-2	43,820	0	0	0	0	43,820
3i-4	23,150	4,940	5,140	1,320	3,450	38,000
3i-8	20,890	3,440	1,260	1,840	2,740	30,170
Total	87,860	8,380	6,400	3,160	6,190	111,990
Barkman Creek						
3-47	10,250	410	0	0	530	11,190
3-48	51,080	2,040	0	0	2,660	55,780
Total	61,330	2,450	0	0	3,190	66,970

Continued ----

4-24879

Exhibit 21 - Estimated Average Annual Flood Damages for Watersheds Considered Feasible for Development Within 10-15 Years, Red River Basin Study Area--Continued

Tributary Basin and CNI Watershed	Floodwater: Agricultural	Floodwater: Nonagricultural	Sediment	Erosion	Indirect	Total
	- - - - - - dollars - - - - - - -					
Little River						
3j-4	78,010	11,130	4,760	1,200	9,510	104,610
Total	78,010	11,130	4,760	1.200	9,510	104,610
McKinney Bayou						
3-52	150,370	0	0	0	0	150,370
3-53	216,560	0	0	0	0	216,560
3-54	86,420	0	0	0	0	86,420
Total	453,350	0	0	0	0	453,350
Sulphur River						
3k-9	24,900	2,440	1,170	240	2,880	31,630
3k-11	240	3,230	50	0	350	3,870
3k-12	14,270	2,140	1,090	440	1,790	19,730
3k-14	59,250	14,960	8,850	24,100	10,710	117,870
3k-17	107,250	9,900	6,595	2,810	12,510	139,065
3k-18	80,640	7,500	1,580	1,950	9,170	100,840
Total	286,550	40,170	19,335	29,540	37,410	413,005
Posten Bayou						
3-57	347,160	0	0	0	20,620	367,780
Total	347,160	0	0	0	20,620	367,780
Red River Main Stem						
3-60	30,350	0	0	0	3,040	33,390
Total	30,350	0	0	0	3,040	33,390
Loggy Bayou						
3m1-7	24,150	26,250	0	0	5,040	55,440
3m2-3	59,950	0	0	0	0	59,950
3m-1	3,150	100	1,360	110	520	5,240
Total	87,250	26,350	1,360	110	5,560	120,630
Bayou Pierre						
3n-2	48,310	10,000	270	750	5,930	65,260
Total	48,310	10,000	270	750	5,930	65,260
Cane River						
3-66	83,180	1,840	350	230	1,510	87,110
3-64	21,240	1,340	240	160	1,100	24,080
3-65	26,910	3,040	570	390	2,490	33,400
Total	131,330	6,220	1,160	780	5,100	144,590

Continued ---

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Exhibit 21 - Estimated Average Annual Flood Damages for Watersheds Considered Feasible for Development Within 10-15 Years, Red River Basin Study Area-- Continued

Tributary Basin: and CNI Watershed	Floodwater: Agricultural	Floodwater: Nonagricultural	Sediment	Erosion	Indirect	Total
	- - - - - - dollars - - - - - - -					
Bayou Rigolette						
3-69	51,360	2,570	0	0	2,700	56,630
3-70	220,540	11,300	4,100	0	11,800	247,740
Total	271,900	13,870	4,100	0	14,500	304,370
Red River Backwater						
3-76	179,350	0	-	-	17,930	197,280
3-75	272,060	0	-	-	6,720	278,780
3-73	117,860	0	-	-	-	117,860
Total	569,270	0	-	-	24,650	593,920
Chatlin Lake & Associated Areas						
10-11 & 12	53,390	0	-	-	-	53,390
10-15	0	0	0	0	0	0
10-10	162,575	0	-	-	-	162,575
10-13 & 14	572,860	0	-	-	-	572,860
10-16	368,250	0	-	-	-	368,250
Total	1,157,075	0	-	-	-	1,157,075
Grand Total	5,291,345	380,410	114,625	139,440	315,960	6,241,780

1/ Adjusted normalized prices

4-24879

Exhibit 22 - Water Use 1/ by Heavy Forest Industry, Red River Basin Study Area, 1962 to 1980

Status of Mill or Expansion	Year of Estimated Period of Completion	Town	County or Parish	Pulp Capacity and Process (Tons/day)	Ground (mil.gal./day)	Surface (mil.gal./day)	Surface Source	Status of Water Supply	Effluent Disposal (act. or probable)
ARKANSAS:									
Under Construction	1968	Ashdown	Little River	400-BK 200-G	---	25	Millwood Reservoir	Max. of 75 mm. is available	Red River
Planned	1970-80	Fulton	Hempstead	est. 600-K	---	est. 25	Red River		Red River
LOUISIANA:									
Operating	---	Springhill	Webster	725-BK 850-K	est. 15	est. 35	Lake Erling (Bodcau Bayou)	Est.: Needs may increase in future	Bodcau Bayou, Loggy Bayou, Red River
Operating	---	Shreveport	Caddo	135-G	1.25	---		Est.: No substantial increases	Red River
Under Construction	1968	Pineville	Rapides	300-K 200-BK	25	Some use likely	Castor Creek (Rapides Parish)	Est.: Initial needs are available	Red River
Feasible	1970-80		Grant or Rapides	est. 600-K	---	25	Lake Iatt (Grant Parish)	Max. of 60 mm. was planned	Red River
Feasible	1970-80		Natchitoches or Grant	est. 600-K	Some use likely	est. 25	Non established	Est.: 35-40 mm. will be needed	Red River
OKLAHOMA									
Feasible	1970-80	Hugo	Choctaw	est. 600-K		est. 35	Hugo Reservoir	Res. Construction authorized	Lower Kiamichi River
TEXAS									
Planned	1970-80	New Boston	Bowie	est. 600-K	---	est. 25	Red River and Barkman Creek	Tentative approval by State	Red River
Planned	1970-80	Texarkana	Bowie	est. 660-K		est. 35	Impoundment to be constructed	To be reserved in State Water Plan	Red River

PAPER-MAKING PROCESSES: K - Kraft (Sulphate); BK - Bleached Kraft; G - Groundwood

NOTE: 600 tons is considered the minimum efficient operating capacity for pulp and paper mills. Once established, they tend to expand to fit the available raw material. Market conditions for pulp products are favorable for the foreseeable future.

1/ Net needs based on reasonable reuse.

Exhibit 23 - Land Capability Class and Subclass Distribution by Major Land Uses, Arkansas, 1962 Conditions

Land Capability Class and Subclass	Cropland	Grazing Land	Woodland	Miscellaneous Land	Total
	- - - - - - - - - - - thousand acres - - - - - - - - - - -				
Class I Total	60.1	33.8	74.6	-	168.5
Subclass IIe	102.8	95.5	267.8	-	466.1
Subclass IIs	63.2	23.8	21.4	-	108.4
Subclass IIw	21.3	9.1	76.6	-	107.0
Class II Total	187.3	128.4	365.8	-	681.5
Subclass IIIe	97.0	71.1	328.2	-	496.3
Subclass IIIs	-	0.8	7.3	-	8.1
Subclass IIIw	30.1	40.6	256.8	-	327.5
Class III Total	127.1	112.5	592.3	-	831.9
Subclass IVe	5.4	22.8	145.0	-	173.2
Subclass IVs	3.7	3.1	6.0	-	12.8
Subclass IVw	1.0	12.6	168.7	-	182.3
Class IV Total	10.1	38.5	319.7	-	368.3
Subclass Vw	1.4	16.0	235.1	-	302.5
Class V Total	1.4	16.0	285.1	-	302.5
Subclass VIe	1.3	12.6	146.7	-	160.6
Subclass VIs	0.9	-	15.4	-	16.3
Class VI Total	2.2	12.6	162.1	-	176.9
Subclass VIIe	-	1.0	35.5	-	36.5
Subclass VIIs	-	0.4	78.4	-	78.8
Class VII Total	-	1.4	113.9	-	115.3
Unclassified	-	-	-	15.8	15.8
Total	388.2	343.2	1,913.5	15.8	2,660.7

Continued ---

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Exhibit 23 - Land Capability Class and Subclass Distribution by Major Land Uses, Louisiana, 1962 Conditions--Continued

Land Capability Class and Subclass	Cropland	Grazing Land	Woodland	Miscellaneous Land	Total
	thousand acres				
Class I Total	169.9	63.2	25.2	13.5	271.8
Subclass IIe	72.0	89.7	335.6	50.9	548.2
Subclass IIs	2.2	1.2	28.7	2.0	34.1
Subclass IIw	145.8	142.2	203.8	21.2	513.0
Class II Total	220.0	233.1	568.1	74.1	1,095.3
Subclass IIIe	41.2	106.0	517.3	42.2	706.7
Subclass IIIs	3.7	3.8	84.5	7.8	99.8
Subclass IIIw	129.9	171.5	362.4	12.0	675.8
Class III Total	174.8	281.3	964.2	62.0	1,482.3
Subclass IVe	7.4	31.4	186.6	23.8	249.2
Subclass IVs	0.1	0.8	5.4	0.2	6.5
Subclass IVw	-	13.4	169.3	0.7	183.4
Class IV Total	7.5	45.6	361.3	24.7	439.1
Subclass Vw	1.1	103.0	836.0	3.1	943.2
Class V Total	1.1	103.0	836.0	3.1	943.2
Subclass VIe	0.6	14.9	142.0	4.3	161.8
Class VI Total	0.6	14.9	142.0	4.3	161.8
Subclass VIIe	0.2	24.6	183.1	5.0	212.9
Subclass VIIs	-	0.3	19.5	1.5	21.3
Class VII Total	0.2	24.9	202.6	6.5	234.2
Total	574.1	766.0	3,099.4	188.2	4,627.7

Continued---

Exhibit 23 - Land Capability Class and Subclass Distribution by Major Land Uses, Oklahoma, 1962 Conditions--Continued

Land Capability Class and Subclass	Cropland	Grazing Land	Woodland	Miscellaneous Land	Total
	thousand acres				
Class I Total	97.4	29.1	50.5	4.4	181.4
Subclass IIe	174.0	126.5	78.1	34.6	413.2
Subclass IIs	28.2	11.6	2.6	6.2	48.6
Subclass IIw	-	5.8	36.3	0.5	42.6
Class II Total	202.2	143.9	117.0	41.3	504.4
Subclass IIIe	219.5	244.7	158.9	85.4	708.5
Subclass IIIw	46.0	36.3	69.4	2.3	154.0
Class III Total	265.5	281.0	228.3	87.7	862.5
Subclass IVe	29.4	100.4	115.8	21.3	266.9
Subclass IVs	-	1.5	10.3	3.7	15.5
Subclass IVw	0.6	6.9	14.6	0.9	23.0
Class IV Total	30.0	108.8	140.7	25.9	305.4
Subclass Vw	20.7	52.5	344.3	16.9	434.4
Class V Total	20.7	52.5	344.3	16.9	434.4
Subclass VIe	17.1	112.8	343.9	59.5	533.3
Class VI Total	17.1	112.8	343.9	59.5	533.3
Subclass VIIs	0.1	204.1	1,850.0	4.2	2,058.4
Class VII Total	0.1	204.1	1,850.0	4.2	2,058.4
Total	633.0	932.2	3,074.7	239.9	4,879.8

Continued ---

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Exhibit 23 - Land Capability Class and Subclass Distribution by Major Land Uses, Texas, 1962 Conditions--Continued

Land Capability Class and Subclass	Cropland	Grazing Land	Woodland	Miscellaneous Land	Total
	- - - - - - - - - - - thousand acres- - - - - - - - - - -				
Class I Total	48.0	21.3	12.4	-	81.7
Subclass IIe	416.9	124.0	72.5	-	613.4
Subclass IIs	250.1	74.8	74.1	-	399.0
Subclass IIw	23.5	5.1	2.9	-	31.5
Class II Total	690.5	203.9	149.5	-	1,043.9
Subclass IIIe	691.2	433.5	384.1	-	1,508.8
Subclass IIIs	53.3	25.3	47.0	-	125.6
Subclass IIIw	12.5	13.3	83.8	-	109.6
Class III Total	757.0	472.1	514.9	-	1,744.0
Subclass IVe	115.2	113.2	228.1	-	456.5
Subclass IVs	0.6	-	-	-	0.6
Subclass IVw	25.3	27.4	222.7	-	275.4
Class IV Total	141.1	140.6	450.8	-	732.5
Subclass Vw	81.9	151.7	578.7	-	812.3
Class V Total	81.9	151.7	578.7	-	812.3
Subclass VIe	9.7	14.4	175.2	-	199.3
Subclass VIs	-	2.8	0.6	-	3.4
Class VI Total	9.7	17.2	175.8	-	202.7
Subclass VIIe	64.3	112.7	314.9	-	491.9
Subclass VIIs	-	-	1.8	-	1.8
Class VII Total	64.3	112.7	316.7	-	493.7
Unclassified	1.3	-	-	53.0	54.3
Total	1,793.8	1,119.5	2,198.8	53.0	5,165.1

Continued -----

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Exhibit 23-Land Capability Class and Subclass Distribution by Major Land Uses, Red River Basin Study Area, 1962 Conditions--Continued

Land Capability Class and Subclass	Cropland	Grazing Land	Woodland	Miscellaneous Land	Total
	- - - - - - - - - - thousand acres - - - - - - - - - -				
Class I Total	375.4	147.4	162.7	17.9	703.4
Subclass IIe	765.7	435.7	754.0	85.5	2,040.9
Subclass IIs	343.7	111.4	126.8	8.2	590.1
Subclass IIw	190.6	162.2	319.6	21.7	694.1
Class II Total	1,300.0	709.3	1,200.4	115.4	3,325.1
Subclass IIIe	1,048.9	855.3	1,388.5	127.6	3,420.3
Subclass IIIs	57.0	29.9	138.8	7.8	233.5
Subclass IIIw	218.5	261.7	772.4	14.3	1,266.9
Class III Total	1,324.4	1,146.9	2,299.7	149.7	4,920.7
Subclass IVe	157.4	267.8	675.5	45.1	1,145.8
Subclass IVs	4.4	5.4	21.7	3.9	35.4
Subclass IVw	26.9	60.3	575.3	1.6	664.1
Class IV Total	188.7	333.5	1,272.5	50.6	1,845.3
Subclass Vw	105.1	323.2	2,044.1	20.0	2,492.4
Class V Total	105.1	323.2	2,044.1	20.0	2,492.4
Subclass VIe	28.7	154.7	807.8	63.8	1,055.0
Subclass VIs	0.9	2.8	16.0	-	19.7
Class VI Total	29.6	157.5	823.8	63.8	1,074.7
Subclass VIIe	64.5	138.3	533.5	5.0	741.3
Subclass VIIs	0.1	204.8	1,949.7	5.7	2,160.3
Class VII Total	64.6	343.1	2,483.2	10.7	2,901.6
Unclassified	1.3	-	-	68.8	70.1
Total	3,389.1	3,160.9	10,286.4	496.9	17,333.3

Source: 1958 National Inventory of Soil and Water Conservation Needs adjusted to 1962 conditions and rounded to nearest 100 acres

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Exhibit 24 - Status and Management Policy of Federally Owned Forest Lands, Red River Basin Study Area, 1962

State, County or Parish and Installation	Total Area	Forested Area	Other Area	Accessible to Public	Type of Land Management
	- - - - - - - -	acres	- - - -		
Arkansas					
Howard					
Ouachita National Forest	300	300	-	300	Multiple-use, includes recreation
Lafayette					
Bodcau Reservoir, CE	1,150	1,150	-	1,150	Multiple-use, principally hunting available for other recreation
Polk					
Ouachita National Forest	105,500	105,500	-	105,500	Multiple-use, includes recreation
TOTAL, Arkansas	106,950	106,950	-	106,950	
Louisiana					
Bossier					
Barksdale Air Force Base	22,031	17,642	4,389	Limited (17,642)	Multiple forest use, public use by special permit only
Bodcau Reservoir, CE	26,490	26,490	-	26,490	Multiple-use, principally hunting available for other recreation
La. Ordnance Plant (AMC)	1,600	1,600	-	None	Timber, W/S protection and wildlife production
Total, Bossier Parish	50,121	45,732	4,389	26,490	
Claiborne					
Kisatchie National Forest	500	500	-	500	Multiple-use, includes recreation
Grant					
Kisatchie National Forest	41,800	41,800	-	41,800	Multiple-use, includes recreation
Natchitoches					
Kisatchie National Forest	122,000	122,000	-	122,000	Multiple-use, includes recreation
Camp Polk Military Reservation	4,900	4,900	-	None	Limited management for timber production and W/S protection
Total, Natchitoches Parish	126,900	126,900	-	122,000	
Rapides					
England Air Force Base	2,400	-	2,400	None	No area for recreational development
Kisatchie National Forest	7,100	7,100	-	7,100	Multiple-use, includes recreation
Miscellaneous parcels	1,735	-	1,735	None	No area for recreation development
Total Rapides Parish	11,235	7,100	4,135	7,100	
Sabine					
Camp Polk Military Reservation	5,400	5,400	-	None	Limited Management for timber production and W/S protection
Vernon					
Camp Polk Military Reservation	4,500	4,500	-	None	Limited Management for timber production and W/S protection
Webster					
Bodcau Reservoir, CE	9,400	9,400	-	9,400	Multiple-use, principally hunting, Available for other recreation
Kisatchie National Forest	11,684	11,684	-	11,684	Multiple-use, includes recreation
La. Ordnance Plant (AMC)	11,900	4,289	7,611	None	Timber and wildlife production and W/S protection
Total, Webster Parish	32,984	25,373	7,611	21,084	
Winn					
Kisatchie National Forest	59,300	59,300	-	59,300	Multiple-use, includes recreation
TOTAL, Louisiana	332,740	316,605	16,135	278,274	
Oklahoma					
LeFlore					
Ouachita National Forest	85,300	85,300	-	85,300	Multiple-use, includes recreation
McCurtain					
Ouachita National Forest	50,300	50,300	-	50,300	Multiple-use, includes recreation
Pittsburg					
Naval Ordnance Depot	4,300	1,280	3,020	None	Wildlife production
TOTAL, Oklahoma	139,900	136,880	3,020	135,600	
Texas					
Bowie					
Red River Depot and Lone Star Ordnance Plant (AMC)	35,725	28,000	7,725	None	Timber and wildlife production and W/S protection
Texarkana Reservoir, CE 1/	35,500	34,850	650	34,850	Limited multiple-use, dedicated mostly to recreation
Federal Correctional Inst.	875	-	875	None	Not available for recreation
Total, Bowie	72,100	62,890	9,250	34,850	

Continued ----

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Exhibit 24 - Status and Management Policy of Federally Owned Forest Lands, Red River Basin Study Area, 1962--Continued

State, County or Parish and Installation	Total Area	Forested Area	Other Area	Accessible to Public	Type of Land Management
			acres		
Camp					
Ferrells Bridge Reservoir, CE	1,200	1,200	-	1,200	Limited multiple-use, dedicated mostly to recreation
Cass					
Texarkana Reservoir, CE	22,600	22,175	425	22,175	Limited multiple-use, dedicated mostly to recreation
Fannin					
Panhandle National Grasslands	19,028	2/ 530	18,498	19,028	Managed range lands and 1,070 acres water. Available for recreation
Grayson					
Texhoma Reservoir, CE	600	-	600	600	Used mainly for recreation
Harrison					
Longhorn Arsenal (AMC)	8,600	4,500	4,100	None	Timber and wildlife production and W/S protection. No recreation
Marion					
Ferrell's Bridge Reservoir, CE	6,100	5,740	360	5,740	Limited multiple-use, dedicated mostly to recreation
Morris					
Ferrell's Bridge Reservoir, CE	1,000	1,000	-	1,000	Limited multiple-use, dedicated mostly to recreation
Upshur					
Ferrell's Bridge Reservoir, CE	2,300	2,300	-	2,300	Limited multiple-use, dedicated mostly to recreation
TOTAL, Texas	133,528	100,295	33,233	86,893	

1/ Corps of Engineers management of reservoir lands does not include regular timber harvest. Entire area will probably be devoted to meeting recreation demands.
2/ This area was included in inventoried lands in 1958 CNI. No commercial forest land.

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Exhibit 25 - 1962 Summarization of Treatment Accomplished on Private Forest Lands, Red River Basin Study Area

Measure	Total Acres to 12/31/62
Field Planting	306,290
Interplanting	23,900
Underplanting	25,900
Timber stand improvement	657,500
Total	1,013,590

Source: State Forest agencies and SCS records, reports by forest industry

Exhibit 26 - 1953-62 (10-year) Summarization of Treatment Accomplished on National Forest System Lands, Red River Basin Study Area

Measure	Unit	Total Installed 1953 - 62
Tree planting	Acres	42,894
Timber stand improvement	Acres	253,307
Range improvement (reseeding)	Acres	2,012
Erosion control	Acres	2,244
Channel stabilization	Miles	13
Total	Acres	300,457
	Miles	13

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Exhibit 27 - 1962 Development of Recreation Facilities on National Forest System Lands on Base Area, Red River Basin Study

Use	Unit	Number	Acres	Miles
Camping	Family Unit	132	65	
Picnicking	Family Unit	177	77	
Hiking	Trail	4		3.5
Vistas	Stop 1/	2	1	
Swimming	Area 2/	10	19	
Boating	Area 3/	4	1,060	
Total Development			1,222	3.5

1/ Includes parking area
2/ Includes beach area with bathhouse and showers
3/ Includes dock or ramp facilities

Exhibit 28 - 1963 - June 30, 1966, Development of Recreation Facilities on National Forest System Lands, Base Area, Red River Basin Study

Use	Unit	Number	Acres	Miles
Camping	Family Unit	145	50	
Picnicking	Family Unit	79	25	
Hiking	Trail	1		.5
Vistas	Stop 1/	4	4	
Swimming	Area 2/	3	4	
Boating	Area 3/	1	8	
Total Development		233	91	.5

1/ Includes parking areas
2/ Includes beach area with bathhouse and showers
3/ Includes dock or ramp facilities

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Exhibit 29 - Summary of livestock and livestock products requirements, Red River Basin Study Area, 1962, 1980, and 2010

Commodity	Unit	1962	1980	2010
		- - - millions - - -		
Beef and veal 1/.....	Lbs.	622.9	1,131.9	2,339.1
Lamb and mutton 1/.....	Lbs.	2.0	3.0	8.0
Pork 1/.....	Lbs.	85.5	69.2	115.5
Chickens 1/	Lbs.	13.0	18.1	35.1
Turkeys 1/	Lbs.	4.9	16.7	29.4
Milk 2/	Lbs.	565.9	1,061.4	2,841.8
Eggs	No.	571.4	1,693.7	2,782.4

1/ Live weight
2/ Fat solid basis
Note: Requirements conform to July 1965 ERS data. "Current and Projected Agricultural Product Requirements, U.S." Table 4, page 8

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Exhibit 30 - Food and Fiber Requirements, Red River Basin Study Area, 1962 projected 1980 and 2010

Crop	Unit	1962	1980	2010
		- thousands -		
Cotton	500# bale	323	175	249
Feed grains:				
Corn	Bu.	6,136	2,146	3,470
Oats	Bu.	1,264	1,169	2,063
Barley	Bu.	350	870	1,765
Sorghum, grain	Bu.	1,882	4,435	6,818
Feed units:		495,261	427,369	692,700
Wheat	Bu.	2,014	5,565	6,661
Rice	Lbs.	269,300	424,400	524,900
Soybeans	Bu.	1,684	5,626	8,159
Peanuts	Lbs.	46,162	48,040	78,430
Sweet Potatoes	Bu.	4,183	5,120	8,410
Vegetables	Cwt.	1,613	1,955	3,206
Alfalfa & mixture	Ton	171	257	417
Other hay	Ton	823	1,271	2,355
Sugarcane for sugar	Ton	35	210	439
Fruits, non-citrus	Ton	17	11	25
Miscellaneous				

Note: Requirements conform to July 1965 ERS data, "Current and Projected Agricultural Product Requirements, U. S.," and "U. S. Feed Grain Requirements"

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Exhibit 31 - Annual Household Water Requirements: Rural Farm and Rural Non-farm, Red River Basin Study Area, 1962, 1980, and 2010

Year	Gallons Used per day per person 1/	Annual household water requirement		
		Rural farm	Rural non-farm	Total
		- - - million gallons - - -		
1962	70	4,928	17,848	22,776
1980	100	4,515	26,773	31,288
2010	119	3,705	33,549	37,254

1/ Estimates based on research conducted within the Red River Basin Study Area

Exhibit 32 - Livestock numbers and Water Requirements, Red River Basin Study Area 1/, 1962, Projected 1980 and 2010

Livestock	Livestock Number			Daily Water Use Per Head	Annual Water Requirements		
	1962	1980	2010		1962	1980	2010
	- - thousands - -			gallons	- - million gallons		
Cattle & calves	2,110	2,808	3,970	15	11,552	15,374	21,736
Horses & mules	58	38	23	10	212	139	84
Hogs & pigs	305	252	230	3	334	276	252
Sheep & lambs	58	68	85	2	42	52	62
Broilers 2/	70,159	107,450	225,645	.04	236	362	760
Chickens, 4 mos. & older	3,460	7,907	9,884	.04	51	115	144
Turkeys	228	248	281	.06	5	5	6
Total	-	-	-	-	12,432	16,323	23,044

1/ Whole counties are represented in the four Basin States of Arkansas, Louisiana, Oklahoma, & Texas

2/ Assumed 12 weeks for total broiler production

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Exhibit 33 - Recreation Demand: Existing and Projected Total Annual, Summer, and Average Sunday Demand in Activity Occasions by Sub-areas, Red River Basin Study Area, 1960, 1980, and 2020

Activity or Activity Group	Average Summer Sunday				Total Summer				Total Annual			
	Participation: Rate Per ($1,000)	Demand in Activity Occasions			Participation: Rate Per ($1,000)	Demand in Activity Occasions (1,000)			Participation: Rate Per ($1,000)	Demand in Activity Occasions (1,000)		
		1960	1980	2020		1960	1980	2020		1960	1980	2020
Sub-area 1												
Canoeing	0.0011	190	400	1,300	0.034	5.9	11.3	39.1	0.056	9.7	18.7	64.4
Boating, Sailing and Waterskiing	0.0212	3,690	7,100	24,400	0.689	119.9	229.9	792.8	1.367	237.8	456.1	1,573.0
Swimming	0.0684	11,900	22,800	78,700	2.224	386.9	742.0	2,559.1	3.104	540.0	1,035.7	3,571.7
Subtotal	-	15,780	30,300	104,400	-	512.7	983.2	3,391.0	-	787.5	1,510.5	5,209.1
Camping	0.0115	2,000	3,800	13,200	0.213	37.1	71.1	245.1	0.443	77.1	147.8	509.8
Picnicking	0.0226	3,930	7,500	26,000	0.734	127.7	244.9	844.6	1.552	270.0	517.8	1,785.9
Subtotal	-	5,930	11,300	39,200	-	164.8	316.0	1,089.7	-	347.1	665.6	2,295.7
Playing Games	0.0051	890	1,700	5,900	0.165	28.7	55.1	189.9	0.721	125.4	240.6	829.6
Fishing (Incidental)	0.0076	1,320	2,500	8,700	0.246	42.8	82.1	283.1	0.593	103.2	197.9	682.4
Sightseeing	0.0276	4,800	9,200	31,800	0.896	155.9	299.0	1,031.0	2.851	496.0	951.2	3,280.6
Hiking	0.0029	500	1,000	3,300	0.095	16.5	31.7	109.3	0.196	34.1	65.4	225.5
Nature Walks	0.0095	1,650	3,200	10,900	0.308	53.6	102.8	354.4	1.485	258.4	495.5	1,708.8
Subtotal	-	9,160	17,600	60,600	-	297.5	570.7	1,967.7	-	1,017.1	1,950.6	6,726.9
Total	-	30,870	59,200	204,200	-	975.0	1,869.9	6,448.4	-	2,151.7	4,126.7	14,231.7
Sub-area 2												
Canoeing	0.0011	130	274	1,110	0.034	4.1	8.5	34.2	0.056	6.8	13.9	56.4
Boating, Sailing and Waterskiing	0.0212	2,560	5,280	21,360	0.689	83.4	171.6	694.1	1.367	165.4	340.5	1,377.2
Swimming	0.0684	8,280	17,040	68,910	2.224	269.1	554.0	2,240.5	3.104	375.5	773.2	3,127.1
Subtotal	-	10,970	22,594	91,380	-	356.6	734.1	2,968.8	-	547.7	1,127.6	4,560.7
Camping	0.0115	1,390	2,860	11,580	0.213	25.8	53.1	214.6	0.443	53.6	110.4	446.3
Picnicking	0.0226	2,730	5,630	22,770	0.734	88.8	182.8	739.4	1.552	187.8	386.6	1,563.5
Subtotal	-	4,120	8,490	34,350	-	114.6	235.9	954.0	-	241.4	497.0	2,009.8
Playing Games	0.0051	620	1,270	5,140	0.165	20.0	41.1	166.2	0.721	87.2	179.6	726.4
Fishing (Incidental)	0.0076	920	1,890	7,660	0.246	29.8	61.3	247.8	0.593	71.7	147.7	597.4
Sightseeing	0.0276	3,340	6,880	27,800	0.896	108.4	223.2	902.6	2.851	344.9	710.2	2,872.2
Hiking	0.0029	350	720	2,920	0.095	11.5	23.7	95.7	0.196	23.7	48.8	197.5
Nature Walks	0.0095	1,150	2,370	9,570	0.308	37.3	76.7	310.7	1.485	179.7	369.9	1,496.0
Subtotal	-	6,380	13,130	53,090	-	207.0	426.0	1,722.6	-	707.2	1,456.2	5,889.5
Total	-	21,470	44,214	178,820	-	678.2	1,396.0	5,645.4	-	1,496.3	3,080.8	12,460.0
Sub-area 3												
Canoeing	0.0011	490	1,020	4,320	0.034	15.2	31.6	133.5	0.056	25.0	52.1	219.9
Boating, Sailing and Waterskiing	0.0212	9,460	19,730	83,230	0.689	307.3	641.4	2,705.0	1.367	609.7	1,272.0	5,366.9
Swimming	0.0684	30,500	63,650	268,540	2.224	991.9	2,069.4	8,731.5	3.104	1,384.4	2,888.3	12,186.5
Subtotal	-	40,450	84,400	356,090	-	1,314.4	2,752.1	11,570.0	-	2,019.1	4,212.4	17,773.3
Camping	0.0115	5,130	10,700	45,150	0.213	95.0	198.2	451.5	0.443	197.6	412.2	1,739.2
Picnicking	0.0226	10,080	21,030	88,730	0.734	327.4	683.0	2,881.7	1.552	692.2	1,444.1	6,093.2
Subtotal	-	15,210	31,730	133,880	-	422.4	881.2	3,333.2	-	889.8	1,856.3	7,832.4
Playing Games	0.0051	2,270	4,750	20,020	0.165	73.6	153.5	647.8	0.721	321.6	670.9	2,830.7
Fishing (Incidental)	0.0076	3,390	7,070	29,840	0.246	109.7	228.9	965.8	0.593	264.5	551.8	2,328.1
Sightseeing	0.0276	12,300	25,680	108,360	0.896	399.6	833.7	3,517.7	2.851	1,271.5	2,652.8	11,198.2
Hiking	0.0029	1,290	2,700	11,360	0.095	42.4	88.4	373.0	0.196	87.4	182.4	769.5
Nature Walks	0.0095	4,240	8,840	37,300	0.308	137.4	286.6	1,209.2	1.485	662.3	1,381.8	5,830.2
Subtotal	-	23,490	49,040	206,880	-	762.7	1,591.1	6,713.5	-	2,607.3	5,439.7	22,951.7
Total	-	79,150	165,170	696,850	-	2,499.5	5,224.4	21,616.7	-	5,516.2	11,508.4	48,557.4
Sub-area 4												
Canoeing	0.0011	1,410	3,150	11,770	0.034	43.6	97.4	363.7	0.056	71.9	160.3	599.0
Boating, Sailing and Waterskiing	0.0212	27,220	60,700	226,750	0.689	884.6	1,972.7	7,369.4	1.367	1,755.1	3,913.9	14,621.1
Swimming	0.0684	87,820	195,840	731,590	2.224	2,855.4	6,367.6	23,787.4	3.104	3,985.2	8,887.2	33,200.0
Subtotal	-	116,450	259,690	970,110	-	3,783.6	8,437.7	31,520.5	-	5,812.2	12,961.4	48,420.1
Camping	0.0115	14,760	32,930	123,000	0.213	273.5	609.8	2,278.2	0.443	568.8	1,268.4	4,738.2
Picnicking	0.0226	29,020	64,710	241,720	0.734	942.4	2,101.5	7,850.7	1.552	1,992.6	4,443.6	16,600.0
Subtotal	-	43,780	97,640	364,720	-	1,215.9	2,711.3	10,128.9	-	2,561.4	5,712.0	21,338.2
Playing Games	0.0051	6,550	14,600	54,550	0.165	211.8	472.4	1,764.8	0.721	925.7	2,064.3	7,711.7
Fishing (Incidental)	0.0076	9,760	21,760	81,290	0.246	315.8	704.3	2,631.2	0.593	761.4	1,607.8	6,342.6
Sightseeing	0.0276	35,440	79,020	295,200	0.896	1,150.4	2,565.4	9,583.4	2.851	3,660.4	8,152.8	30,493.7
Hiking	0.0029	3,720	8,300	31,020	0.095	122.0	272.0	1,016.1	0.196	251.6	561.2	2,096.4
Nature Walks	0.0095	12,200	27,200	101,610	0.308	395.4	881.8	3,294.3	1.485	1,906.6	4,251.8	15,883.2
Subtotal	-	67,670	150,880	563,670	-	2,195.4	4,895.9	18,289.8	-	7,505.7	16,737.9	62,527.6
Sub-area Total	-	227,900	508,210	1,898,500	-	7,194.9	16,044.9	59,939.2	-	15,879.3	35,411.3	132,285.9
Basin Total	-	359,390	776,794	2,978,370	-	11,347.6	24,535.2	93,649.7	-	25,043.5	54,127.2	207,535.0

4-24879

Exhibit 34 - County Income: Population and Per Capita Personal Income, by Sub-area, State and County, Red River Basin Study Area, 1960

Sub-area by state and county	1960 population	Per capita personal income	County income
		dollars	thousand dollars
Sub-area 1			
Oklahoma:			
Atoka	10,352	773	8,002
Bryan	24,252	1,072	25,998
Choctaw	15,637	895	13,995
Coal	5,546	1,082	6,001
Hughes	15,144	1,123	17,007
Johnston	8,517	1,057	9,002
Murray	10,622	1,318	14,000
Pittsburg	34,360	1,193	40,991
Pontotoc	28,089	1,388	38,988
Total	152,519	1,141	173,984
Sub-area 2			
Arkansas:			
Hempstead	19,661	966	18,993
Howard	10,878	1,011	10,998
Little River	9,211	868	7,995
Polk	11,981	1,002	12,005
Sevier	10,156	985	10,004
Oklahoma:			
Latimer	7,738	1,034	8,001
LeFlore	29,106	996	28,990
McCurtain	25,851	619	16,002
Pushmataha	9,088	880	7,997
Total	133,670	905	120,985
Sub-area 3			
Arkansas:			
Miller	31,686	1,136	35,995
Texas:			
Bowie	59,971	1,334	80,001
Delta	5,860	1,024	6,001
Fannin	23,880	1,131	27,008
Franklin	5,101	1,176	5,999
Grayson	73,043	1,492	108,980
Hopkins	18,594	1,237	23,001
Hunt	39,399	1,396	55,001
Lamar	34,234	1,198	41,012
Red River	15,682	1,020	15,996
Titus	16,785	1,370	22,995
Wood	17,653	1,360	24,008
Total	341,888	1,304	445,997

Continued ----

4-24879

Exhibit 34 - County Income: Population and Per Capita Personal Income by Sub-area, State and County, Red River Basin Study Area, 1960--continued

Sub-area by state and county	1960 population	Per capita personal income	County income
		dollars	thousand dollars
Sub-area 4			
Arkansas:			
Columbia	26,400	1,174	30,994
Lafayette	11,030	816	9,000
Nevada	10,700	841	8,999
Louisiana:			
Avoyelles	37,606	824	30,987
Bienville	16,726	1,016	16,994
Bossier	57,622	1,371	79,000
Caddo	223,859	1,693	378,993
Catahoula	11,421	788	9,000
Claiborne	19,407	1,082	20,998
DeSoto	24,248	866	20,999
Evangeline	31,639	759	24,014
Grant	13,330	900	11,997
LaSalle	13,011	1,153	15,002
Lincoln	28,535	1,156	32,986
Natchitoches	35,653	841	29,984
Rapides	111,351	1,176	130,949
Red River	9,978	802	8,002
Sabine	18,564	1,023	18,991
St. Landry	81,493	810	66,009
Webster	39,701	1,285	51,016
Winn	16,034	998	16,002
Texas:			
Camp	7,849	1,147	9,003
Cass	23,496	1,107	26,010
Gregg	69,436	1,685	117,000
Harrison	45,594	1,184	53,983
Marion	8,049	870	7,003
Morris	12,576	1,352	17,003
Panola	16,870	1,126	18,996
Upshur	19,793	1,212	23,989
Total	1,041,971	1,232	1,283,903

Note: The total PCPI for each sub-area is a weighted average based on population and PCPI by county

4-24879

Exhibit 35 - Preliminary Allocation of Fishing Use to Proposed United States Department of Agriculture Reservoir Projects, Red River Basin Study Area, 1980 and 2020 1/

State	CNI Watershed	Normal Pool (Acres)	M/D Fishing 1980	M/D Fishing 2020
1980				
Arkansas	3j-4	60	700	900
	3-52	230	2,800	3,500
	3-56	80	1,000	1,200
	3-57	110	1,300	1,700
	3m-1-7 (3)	194	2,300	2,900
	3m-1-7 (7)	170	2,000	2,600
Sub-total		844	10,100	12,800
Louisiana	3m-2-3 (1)	1,050	15,800	21,000
	3m-2-3 (2)	170	2,600	3,400
	3n-2	1,950	29,300	39,000
	3-65 (21)	60	900	1,200
	3-65 (1)	100	1,500	2,000
	3-65 (35)	80	1,200	1,600
	3-66	80	1,200	1,600
	3-70	480	7,200	9,600
	3-68 & 10-17	1,030	15,500	20,600
Sub-total		5,000	75,200	100,000
Oklahoma	3-23	235	1,200	1,600
	3-35	100	500	700
	3-41	100	500	700
	3i-4	345	1,700	2,400
Sub-total		780	3,900	5,400
Texas	3-19 (35)	250	4,300	4,500
	3-19 (38)	52	900	1,000
	3-25a	340	5,800	6,100
	3-29	24	400	500
	3k-14	306	5,200	5,500
Sub-total		972	16,600	17,600
Totals		7,596	105,800	135,800

Continued ---

4-24879

Exhibit 35 - Preliminary Allocation of Fishing Use to Proposed United States Department of Agriculture Reservoir Projects, Red River Basin Study Area, 1980 and 2020 1/-- Continued

State	CNI Watershed	Normal Pool (Acres)	M/D Fishing 2020
2020			
Arkansas	3-57	60	900
Texas	3k-11	187	3,200
Totals		247	4,100

1/ Methodology developed by Bureau of Sport Fisheries and Wildlife. Based on fishing needs for impounded waters for the individual states. Plans proposed by other Federal and State agencies will offer competitive opportunities and change these gross allocations presented.

4-24879

Exhibit 36 - Existing and Projected "Average Summer Sunday" Demand and Needs for Water-Orientated Recreation Facilities, with Needs Expressed in Facilities, Sub-area 4 1/, Red River Basin Study Area

Supply and demand by time period	Boating	Swimming	Camping	Picnicking
	Act. Occ.	Act. Occ.	Act. Occ.	Act. Occ.
1960				
Average Summer Sunday demand	27,220	87,820	14,760	29,020
Supply:				
Public & private	36,567	11,498	3,729	15,429
SCS 2/	-	-	-	-
Unsatisfied demands	+9,347	76,322	11,031	13,591
Needs expressed in facilities	-	127 acres	2,206 units	1,359 tables
1980				
Average Summer Sunday demand	60,700	195,840	32,930	64,710
Supply:				
Public & private 3/	36,567	17,864	6,930	23,292
1980 SCS	2,777	17,340	1,608	13,055
Unsatisfied demand	21,356	160,636	24,392	28,363
Needs expressed in facilities	42,712 acres	268 acres	4,878 units	2,836 tables
2020				
Average Summer Sunday demand	226,750	731,590	123,000	241,720
Supply:				
Public & private 3/	36,567	17,864	6,930	23,292
2020 SCS	2,804	54,600	5,235	32,900
Unsatisfied demand	187,379	659,126	110,835	185,528
Needs expressed in facilities	374,758	1,099 acres	22,167 units	18,553 tables

Continued ---

1/ Sub-area 4 includes the following counties: Columbia, Lafayette, and Nevada (Arkansas); Avoyelles, Bienville, Bossier, Caddo, Catahoula, Claiborne, DeSoto, Evangeline, Grant, LaSalle, Lincoln, Natchitoches, Rapides, Red River, Sabine, St. Landry, Webster, Winn, (Louisiana); and Camp, Cass, Harrison, Marion, Morris, Upshur, Panola, and Gregg (in Texas).

2/ No Soil Conservation Service projects prior to December 31, 1962 with recreation facilities.

3/ Projected data for 1980 and 2020 are an enlargement of existing facilities that were reported on December 31, 1962. (Table 66) These data do not include SCS facilities.

NOTE: Projected 1980 and 2020 public supply data are not available at this time. When proposed plans for project development are received by BOR, public supply will be delineated by Federal, State, and local agency, including SCS projects.

4-24879

Exhibit 36 - Existing and Projected "Average Summer Sunday" demand and needs for Water-Orientated Recreation Facilities, with Needs Expressed in Facilities, Sub-area 3 1/, Red River Basin Study Area--Continued

Supply and demand by time period	Boating	Swimming	Camping	Picnicking
	Act. Occ.	Act. Occ.	Act. Occ.	Act. Occ.
1960				
Average Summer Sunday demand	9,460	30,500	5,130	10,080
Supply:				
Public & private	16,558	1,852	2,148	7,570
SCS 2/	-	-	-	-
Unsatisfied demand	+7,098	28,648	2,982	2,510
Needs expressed in facilities		48 acres	596 units	251 tables
1980				
Average Summer Sunday demand	19,730	63,650	10,700	21,030
Supply:				
Public & private 3/	16,558	2,886	3,991	11,430
1980 SCS	601	4,020	368	2,870
Unsatisfied demand	2,571	56,744	6,341	6,730
Needs expressed in facilities	5,142 acres	95 acres	1,268 units	673 tables
2020				
Average Summer Sunday demand	83,230	268,540	45,150	88,730
Supply:				
Public & private 3/	16,558	2,886	3,991	11,430
2020 SCS	695	14,760	1,470	8,190
Unsatisfied demand	65,977	250,894	39,689	69,110
Needs expressed in facilities	131,954 acres	418 acres	7,938 units	6,911 tables

Continued ---

1/ Sub-area 3 includes the following counties: Miller (Arkansas); Bowie, Delta, Fannin, Franklin, Grayson, Hopkins, Hunt, Lamar, Red River, Titus, and Wood (in Texas)

2/ No Soil Conservation Service projects prior to December 31, 1962 with recreation facilities.

3/ Projected data for 1980 and 2020 are an enlargement of existing facilities that were reported on December 31, 1962. (Table 66) These data do not include SCS facilities.

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Exhibit 36 - Existing and Projected "Average Summer Sunday" Demand and Needs for Water-Orientated Recreation Facilities, with Needs Expressed in Facilities, Sub-area 2, 1/ Red River Basin Study Area — Continued

Supply and demand by time period	Boating	Swimming	Camping	Picnicking
	Act. Occ.	Act. Occ.	Act. Occ.	Act. Occ.
1960				
Average Summer Sunday demand	2,560	8,280	1,390	2,730
Supply:				
Public & private	4,818	1,199	2,431	7,468
SCS 2/	-	-	-	-
Unsatisfied demand	+2,258	7,081	+1,041	+4,738
Needs expressed in facilities	-	12 acres	-	-
1980				
Average Summer Sunday demand	5,280	17,040	2,860	5,630
Supply:				
Public & private 3/	4,818	1,863	4,528	11,274
1980 SCS	302	3,000	180	1,440
Unsatisfied demand	160	12,177	+1,848	+7,084
Needs expressed in facilities	320 acres	20 acres	-	-
2020				
Average Summer Sunday demand	21,360	68,910	11,580	22,770
Supply:				
Public & private 3/	4,818	1,863	4,528	11,274
2020 SCS	302	6,600	660	3,500
Unsatisfied demand	16,240	60,447	6,392	7,996
Needs expressed in facilities	32,480	101 acres	1,278 units	800 tables

Continued ---

1/ Sub-area 2 includes the following counties: Hempstead, Howard, Little River, Polk, and Sevier, in Arkansas; and Latimer, LeFlore, McCurtain, and Pushmataha in Oklahoma.

2/ No Soil Conservation Service projects prior to December 31, 1962 with recreation facilities

3/ Projected data for 1980 and 2020 are an enlargement of existing facilities that were reported on December 31, 1962. (Table 66) These data do not include SCS facilities.

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Exhibit 36 - Existing and Projected "Average Summer Sunday" Demand and Needs for Water-Orientated Recreation Facilities, with Needs Expressed in Facilities, Sub-area 1 1/, Red River Basin Study Area - Continued

Supply and demand by time period	Boating	Swimming	Camping	Picnicking
	Act. Occ.	Act. Occ.	Act. Occ.	Act. Occ.
1960				
Average Summer Sunday demand	3,690	11,900	2,000	3,930
Supply:				
Public & private	6,907	1,233	1,756	3,595
SCS 2/	-	-	-	-
Unsatisfied demand	+3,217	10,667	244	335
Needs expressed in facilities	-	18 acres	49 units	34 tables
1980				
Average Summer Sunday demand	7,100	22,800	3,800	7,500
Supply:				
Public & private 3/	6,907	1,233	3,264	5,427
1980 SCS	117	720	75	560
Unsatisfied demand	76	20,847	461	1,513
Needs expressed in facilities	152 acres	35 acres	92 units	151 tables
2020				
Average Summer Sunday demand	24,400	78,700	13,200	26,000
Supply:				
Public & private 3/	6,907	1,233	3,264	5,427
2020 SCS	117	2,400	270	1,400
Unsatisfied demand	17,376	75,067	9,666	19,173
Needs expressed in facilities	34,752 acres	125 acres	1,933 units	1,917 tables

1/ Sub-area 1 includes the following counties in Oklahoma: Atoka, Bryan, Choctaw, Coal, Hughes, Johnston, Murray, Pittsburg, and Pontotoc.

2/ No Soil Conservation Service projects prior to December 31, 1962 with recreation facilities

3/ Projected data for 1980 and 2020 are an enlargement of existing facilities that were reported on December 31, 1962.(Table 66) These data do not include SCS facilities.

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Exhibit 37 - Projected Land Utilization to Satisfy Food and Fiber Requirements: Land in Farms, Major Agricultural Use with Crop Distribution, by Major Land Resource Area Groupings, With Project Development, Red River Basin Study Area, 1980

Land Use	LRA 86	LRA 131,134	LRA 85, 112	LRA 80, 84, 133	LRA 119	Study Area Total
	- - - - - - - - - - thousand acres - - - - - - - - - -					
Total cropland:	1,174.5	892.4	271.7	1,367.8	56.4	3,762.8
Cotton	91.8	35.9	4.2	5.7	-	137.6
Corn, silage	1.8	4.6	0.1	5.2	0.4	12.1
Corn, grain	19.6	12.7	2.3	6.5	Z	41.1
Oats	30.6	3.5	2.9	1.4	-	38.4
Barley	36.3	-	-	-	-	36.3
Sorghum, silage	10.3	0.4	2.5	6.0	0.1	19.3
Sorghum, grain	71.4	4.2	20.2	21.5	0.1	117.4
Wheat	207.2	6.5	5.9	2.7	-	222.3
Rice	-	5.5	-	-	-	5.5
Soybeans, forage	6.7	38.0	0.2	1.5	-	46.4
Soybeans, beans	15.6	169.4	9.0	2.4	-	196.4
Peanuts	22.1	Z	24.8	9.2	-	56.1
Sweet potatoes	Z	31.6	Z	11.4	-	43.0
Vegetables	0.7	2.7	0.4	19.0	-	22.8
Cowpeas	0.4	Z	0.1	2.3	-	2.8
Sugarcane/sugar	-	1.0	-	-	-	1.0
Field seed crops (other)	31.6	1.4	0.7	1.3	-	35.0
Alfalfa	38.6	15.2	21.1	9.9	-	84.8
Other hay	140.4	188.0	59.3	343.5	30.0	761.2
Fruit, noncitrus	1.2	5.0	1.3	3.8	-	11.3
Other	0.5	3.6	0.3	0.6	0.1	5.1
Not harvested: idle, fallow, etc.	30.0	41.5	21.5	98.0	3.2	194.2
Pastured	417.7	321.7	94.9	815.9	22.5	1,672.7
Pasture-range	305.5	685.2	558.3	1,024.5	153.2	2,726.7
Forest-woodlands	201.9	815.0	200.0	6,096.6	2,481.4	9,794.9
Grazed	179.8	343.4	136.0	3,241.6	1,364.8	5,265.6
Not grazed	22.1	471.6	64.0	2,855.0	1,116.6	4,529.3
Other land	32.4	76.0	105.4	264.9	19.0	497.7
Total land in farms	1,714.3	2,468.6	1,135.4	8,753.8	2,710.0	16,782.1

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Exhibit 38 - Municipal Water Supply Benefits - Potential Multiple-Purpose Projects for Initial Development, Red River Basin Study Area

Tributary Basin and CNI Watershed	Location	Water Supply Storage	Water Supply Benefits
		acre-feet	dollars
Intervening Area -Texas			
3-19	Sherman, Bells and Howe, Texas	24,127	67,920
3-25a	Bonham, Texas	10,400	19,400
Total		34,527	87,320
Blue River			
3-23	Durant, Oklahoma	8,060	57,480
Total		8,060	57,480
Boggy Creek			
3h2-4	Atoka, Oklahoma	2,000	6,750
3h2-6	Allen, Oklahoma	2,000	6,780
Total		4,000	13,530
Kiamichi River			
3i-4	Antlers, Oklahoma	5,600	33,340
Total		5,600	33,340
Sulphur River			
3k-11	Deport, Texas	354	5,000
Total		354	5,000
Loggy Bayou			
3m1-7	Magnolia, Arkansas	20,300	101,600
3m2-3	Bossier City, Louisiana	4,350	35,200
Total		24,650	136,800
Cane River			
3-64	Provencal, Louisiana	52,560	94,300
Total		52,560	94,300
Grand Total		129,751	427,770

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Exhibit 39 - Water Quality Control Benefits - Potential Multiple Purpose Projects for Initial Development, Red River Basin Study Area

Tributary Basin and CNI Watershed	Pollution Source	Water Quality Control Storage	Water Quality Control Benefits
		acre-feet	dollars
Intervening Area - Texas			
3-25a	Bonham, Texas	5,750	13,500
Blue River			
3-23	Durant, Okla.	2,050	10,000
Sulphur River			
3k-18	Commerce and Wolfe City, Texas	700	6,900
Loggy Bayou			
3m1-7	Magnolia, Ark.	6,000	26,200
Total	---	14,500	56,600

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Exhibit 40 - Recreation Benefits - Potential Multiple-Purpose Projects for Initial Development, Red River Basin Study Area

Tributary Basin and CNI Watershed	Number of Multiple-purpose Structures	Estimated Days of Recreation Use	Recreation Benefits 1/
			dollars
Intervening Area - Texas			
3-19	2	116,370	157,920 2/
3-25a	1	47,400	71,100
3-29	1	7,400	7,400
3-33	-	7,000	3,470 2/
Total	4	178,170	239,890
Intervening Area - Oklahoma - Arkansas			
3-35	1	10,900	16,350
3-41	1	26,000	39,000
3-46	-	6,810	2,750 2/
Total	2	43,710	58,100
Blue River			
3-23	1	50,500	75,750
Total	1	50,500	75,750
Boggy Creek			
3h2-2	1	26,400	51,600 2/
Total	1	26,400	51,600
Kiamichi River			
3i-4	1	30,000	30,000
3i-8	-	5,000	4,140 2/
Total	1	35,000	34,140
Little River			
3j-4	1	30,500	45,750
Total	1	30,500	45,750
McKinney Bayou			
3-52	1	41,200	61,800
Total	1	41,200	61,800
Sulphur River			
3k-11	1	25,300	37,950
3k-14	1	22,300	33,450
Total	2	47,600	71,400
Posten Bayou - (Arkansas)			
3-57	1	24,000	36,000
Total	1	24,000	36,000

Continued ---

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Exhibit 40 - Recreation Benefits - Potential Multiple-Purpose Projects for Initial Development, Red River Basin Study Area--Continued

Tributary Basin and CNI Watershed	Number of Multiple-Purpose Structures	Estimated Days of Recreation Use	Recreation Benefits 1/
			dollars
Loggy Bayou			
3m1-7	1	54,720	82,100
3m2-3	2	129,200	193,800
Total	3	183,920	275,900
Bayou Pierre			
3n-2	1	24,700	37,050
Total	1	24,700	37,050
Cane River			
3-65	3	59,000	88,500
3-66	1	19,700	29,500
Total	4	78,700	118,000
Bayou Rigolette			
3-70	1	26,000	39,000
Total	1	26,000	39,000
Chatlin Lake and Associated Areas			
10-15	2	95,500	92,250
Total	2	95,500	92,250
Grand Total	25	885,900	1,236,630

1/ Adjusted normalized prices, Water Resources Council, April 1966
2/ Includes incidental recreation claimed from sediment pools

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Exhibit 41 - Benefits from Reservoir Sediment Reduction - Potential Multiple-Purpose Projects for Initial Development, Red River Basin Study Area

Tributary Basin and CNI Watershed	Reduction in Annual Sediment Deposition	Reservoir Affected	Average Annual Benefits: Land Treatment	Average Annual Benefits: Structures
	acre-feet		- - dollars - - -	
Intervening Area - Texas				
3-25	12	Lake Davy Crockett Coffee Mill Lake	30	570
3-33	20	Lake Crook	320	780
Total	32		350	1,350
Boggy Creek				
3h1-2	133	Boswell Reservoir	510	5,620
3h1-3	15	Boswell Reservoir	50	740
Total	148		560	6,360
Little River				
3j-4	24	Millwood Reservoir	370	230
Total	24		370	230
Sulphur River				
3k-17	138	Cooper Reservoir	1,200	870
Total	138		1,200	870
Bayou Rigolette				
3-70	28	Lake Iatt	150	1,230
Total	28		150	1,230
Grand Total	370	---	2,630	10,040

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Exhibit 42 - 7/1/66 - 1980 Development, Recreational Facilities on National Forest System Lands on Base 1/ Area, Red River Basin Study Area

Use	Unit	Number	Acres
Camping	Family Unit	673	278
Picnicking	Family Unit	425	149
Vistas 2/	Stop	12	12
Swimming 3/	Area	9	26
Boating 4/	Area	6	589
Total Development		1,125	1,054 5/

1/ Includes whole counties touched by physical basin
2/ Includes parking and viewing area and sanitary facilities
3/ Includes beach area with bathhouse, sanitary facilities and suitable adjacent water
4/ Includes dock or ramp facilities, sanitary facilities, and available water area
5/ Water area keyed to this recreational development (with some hunting and fishing): 2,570 acres

Exhibit 43 - Recreation Benefits - Additional Potential Developments for Recreation to Meet 1980 Needs, Red River Basin Study Area

Tributary Basin and CNI Watershed	Number of Structures	Estimated Days of Recreation Use	Recreation Benefits 1/
			dollars
Boggy Creek			
3h1-2	1	79,200	118,800
Total	1	79,200	118,800
McKinney Bayou			
3-52	1	121,000	181,500
Total	1	121,000	181,500
Bayou Pierre			
3n-5	2	448,800	673,200
Total	2	448,800	673,200
Grand Total	4	649,000	973,500

1/ Adjusted normalized prices, Water Resources Council, April 1966

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